ONTARIO POWER AUTHORITY

5

Supply Mix Submissions and Presentations

Volume 5 – December 2005

Ontario Power Authority

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Supply Mix Submissions and Presentations (Web only)

Volume 5 – December 2005

Volume 5 contains the over 185 submissions and 21 presentations that provided input in the development of OPAs supply mix advice to the Minister of Energy. Submissions were received from individuals, companies, groups and organizations and were discussed in Part 2-3 of the Supply Mix Advice Report. Because in some cases, several parties submitted joint submissions, single parties submitted multiple submissions, or others requested that their advice not be posted, the submissions and presentations listed below may not match exactly with the list provided in Part 2-3.

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APPrO Response to the Invitation to present to the OPA on Ontario's Supply Mix

September 22, 2005

APPrO

ASSOCIATION OF
POWER PRODUCERS
OF ONTARIO

Key Considerations

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- What are “Strategic Factors”?
  - Important or essential considerations
  - Require an intended (and achievable) objective
    - “If you don’t know where you’re going, any road will take you there…”
- Continuing government leadership, coordination and clarity is required
- This presentation is intended only to highlight discussion points around the OPA request – not to advance crystallized policy positions

APPrO Objective

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- Safe, reliable, clean and affordable supply characterized by:
  - Multiple sellers and buyers in the market
  - Consumers pay the full cost of capacity and energy, are exposed to the appropriate elements of risk, and have the market tools to manage risk
  - Appropriate exposure to time of day prices to incent CDM actions; there is equity between buyers and sellers in CDM
  - A process in place to facilitate ongoing emission reduction and energy efficiency improvements

► How does supply mix relate the above?

Important Strategic Factors

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- Government's role should be limited
  - Set objectives and targets – not be prescriptive
- Reliability is the most important criterion
  - Not all MWs are equal
    - Baseload, intermediate, peaking and intermittent
    - Externalities must be considered, e.g. Tx constraints etc.
    - Would typically result in a wide range of acceptable solutions.
    - Numerous technical/financial considerations that must be considered
    - If supply mix planned on assumption all technologies are the same, it will not be able to meet vital reliability criteria
  - Supply Mix and ISP a dynamic and iterative plan – must provide for flexibility going forward
  - T-policy needed to provide guidelines for ISP
- Optimal price
- Environmental footprint
- Economic factors in Ontario need to be considered
- Supply mix as market stands today will have to include a contracting mechanism for foreseeable future

DG and Cogeneration

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- By definition cogen will be baseload
- DG may not be baseload
- Ancillary benefits of DG and cogeneration that need to recognized, e.g.
  - Steam host
  - Environmental
  - System
    - Reduced transmission and distribution line losses, power factor correction, peaking, etc. (e.g., York Region)

DG and Cogeneration

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- Need to find a form of contract that recognizes these benefits and also respects the differences in technology
  - In spite of contracting regime, need to proceed with DG and CHP
    - i.e.. find a contract that works for the technologies
  - technologies can't necessarily bid against each other
    - i.e.. one contract will not fit all, e.g., bilateral contracts
  - There are benefits of cogen and DG that need to be somehow included in the equation

Existing capacity

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- Existing capacity (i.e., NUGs) needs to be treated fairly
  - NUG contracts will begin to expire shortly
  - Capacity support will be required to sustain reliability benefits of existing generators
  - Important to consider these resources – they are “cheaper” than new ones – but not free

Natural Gas and generation

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- Power generators in Ontario have access to numerous supply sources
  - Added gas demand by new proposed power generation is small compared to total demand
  - Canadian and North American supply more than ample to serve Ontario new generation
  - No added infrastructure needed to service the announced CES projects – but not clear what the implications are for more new gas fired generation beyond current tranche….
- 3 legs – how will these play out?
  - *OEB process*
  - *Operational interface between gas and electricity*
  - *How much gas fired generation is appropriate?*
- Operationalizing a cost-effective and efficient interface between day-ahead gas and same day electricity a key issue

Thoughts on Capacity Additions

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- Government
  - Environmental approvals
  - provincial benefits vs. NIMBYism
  - transmission constraints
- Generators
  - Availability of equipment (wind turbines)
  - Lead times for various technologies,
  - Gas transportation issues (e.g.: bypass, unbundled rates etc.)
- Appropriate forms of contracts and risk allocation, transmission and generation interface

Other issues

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- NIMBY-ism
  - Has potential to stop/delay future development
    - Time-consuming, costly, debilitating, politically charged
- Transmission plan
    - Where does this fit in and who is accountable?
    - Necessary part of system plan

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Thank you!

www.appro.org
416 322-6549

BOMA TORONTO

Building Owners and Managers Association of the Greater Toronto Area

Advice to the Ontario Power Authority Regarding Supply Mix

Sept 21,2005

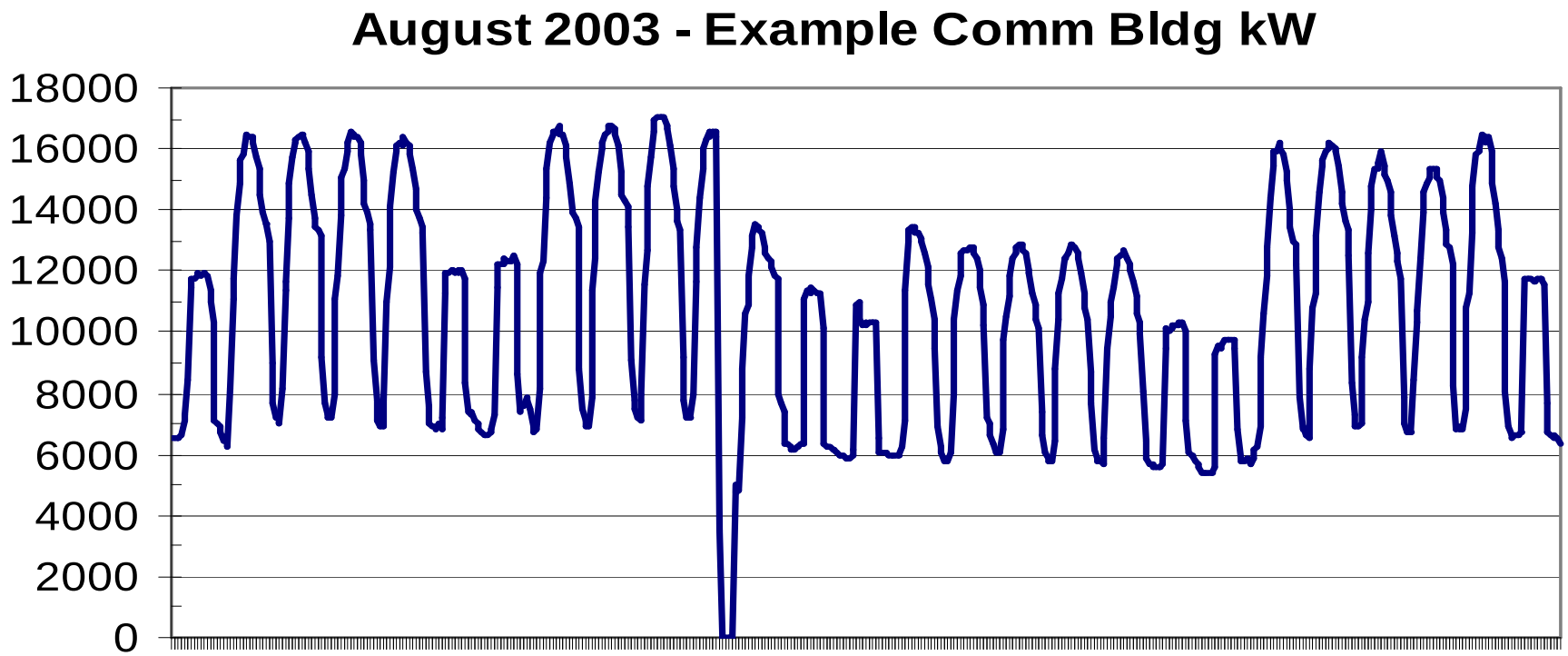
Background:

- **BOMA International: 19,000 members**
- **BOMA Toronto – 690 members, *indirectly representing 25,000 business as tenants. Allied members include recognized energy service providers.***
- **Office, also Institutional, Retail**
- **Some individual building portfolios in the 100 MW range**
- **~ 200 M sq.ft.; ~ 1200 MW**
- **Generally exposed to Wholesale Market Pricing; minority of buildings are RPP.**
- **Typically Net Leases – Costs Passed to Tenants,**
  <u>However</u> - must have competitive operating costs

BOMA Member Profile – Energy Issues

- **Actively support *properly functioning* competitive markets.**
- **Frequent LDC issues. e.g. GA / Prov. Benefit mismatch.**
- **Considerable expertise in Building Systems & Operations.**
- **Many hedged with electricity contracts, majority of these are 'custom block' contracts. Most have expired.**
- **DSM – Ongoing attention to efficiency, active participants in past DSM programs – lighting, mechanical, chillers.**
- **DR - Poised to develop; limited opportunities in Office, more in Retail.**
- **Emergency Generator opportunities?**

Emergency Curtailment following Blackout



- **Shutting off lighting, elevators, tenant loads**
- **Raising temperatures.**
- **Curtailment, *not* conservation – not sustainable**

Issues and Concerns re Supply Mix

- **" it is expected that emergency rotational power outages would be required (in Downtown Toronto) to prevent the overloading of transmission facilities"** ***IESO 10 year highlights*****. Clearly this is unacceptable.**

- **Portland Energy – what's the hold-up? Why can't the players be coordinated to implement Co-Gen?**

- **Hydro One labour disputes further aggravate the timetables for transmission reinforcement.**

- **Generation, DG, DSM and DR urgently needed for downtown Toronto.**

- **Residential sector must be engaged to achieve demand response. Critical Peak Pricing is missing from RPP-TOU.**

Issues and Concerns re Supply Mix (*con't*)

- **Supply Diversity is key.**
- **Reliance on natural gas for baseload introduces substantial risk re availability and cost.**
- **2003 blackout showed a new vulnerability of nuclear – the inability to quickly recover from a forced outage.**
- **Renewables to the greatest extent practical – remove barriers, eg. small hydro. Concern re perception of 'nuisance' small projects.**
- **Distributed Generation. Need to fully develop. Physical diversity provides security, apart from benefits of avoided T&D costs.**
- **CoGen must be further developed from the perspective of efficiency.**
- **DSM and DR can and should be treated as an equivalent resource – but must be a measurable, contractable resource.**

CDM Costs and Potential

- Opposed to LDC program delivery. Need a consistent central approach.
- Need for competition in delivery - good service providers already exist – been there, done that, can do it again.
- Always room for improvement – ongoing evaluation of opportunities.
- Past programs of up to $500/kW for ‘hard measures’ produced results.
- 3 yr notional payback threshold required to incent.
- Deep Lake Water Cooling – a unique opportunity. Major customers are negotiating deals. Untapped potential for marginal projects that may only require incremental funding support.
- DR needs development, price certainty. Ice (cool) storage offers potential.

Impacts of Building Code Changes

- **Support for *practical* code changes based on realizable best practice? (many Min of Environment regs are unworkable).**

- **New Building standards through ASHRAE 90.1 and OBC.**

- **Existing Buildings: BOMA Canada's *Go Green* Program**
  - **Energy and environmental leadership**
  - **Recognition and certification**
  - **Building assessments and ID of tangible improvements.**

  - **Certification now gaining momentum – basis for funding eligibility?**

Solar and the Future of Ontario's Electricity Supply

Canadian Solar
Industries Association

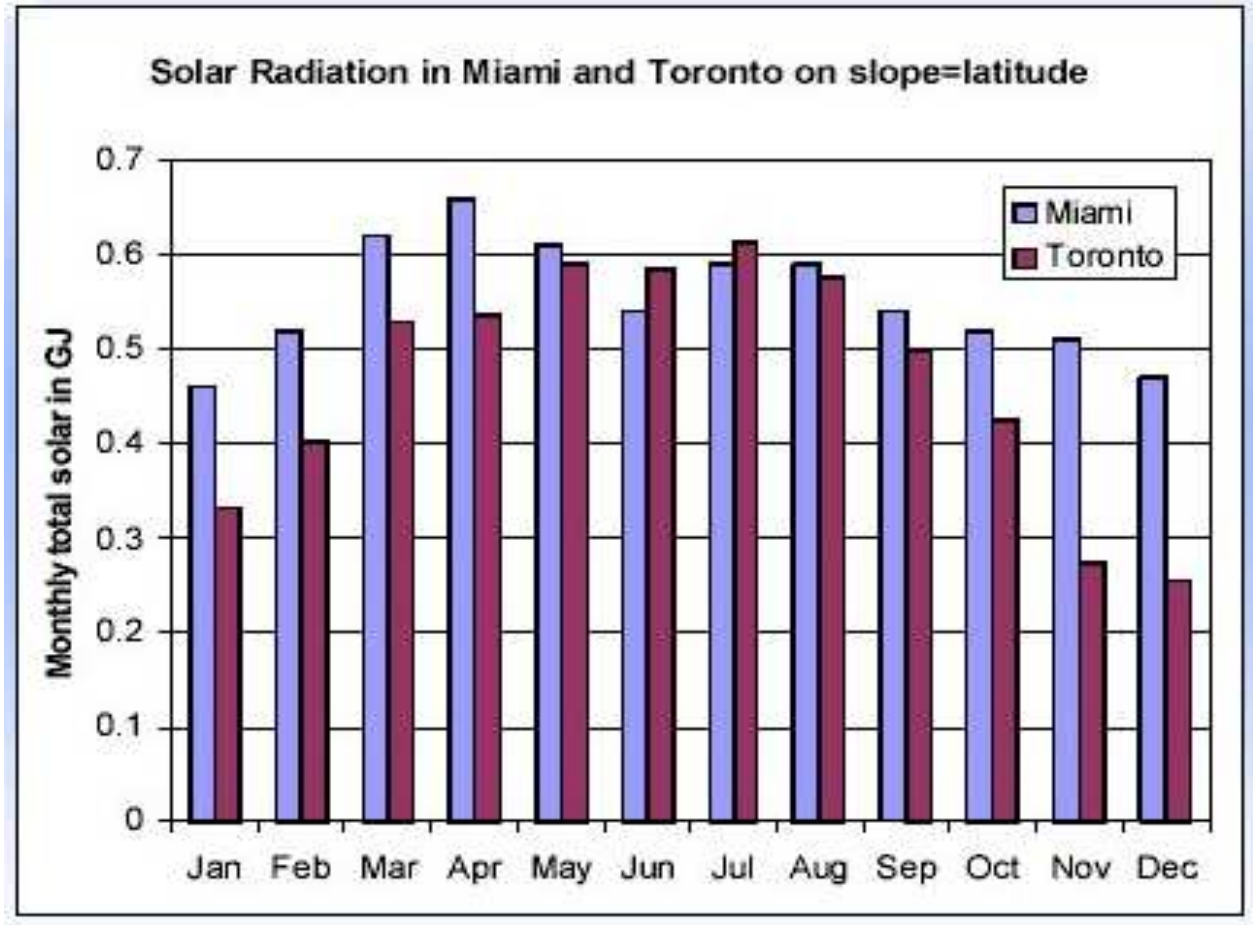
September 22, 2005

Presentation to the Ontario
Power Authority

Solar Technologies

- "Solar" consists of a number of technologies and market "niches"
  - Solar Electricity: grid and off grid
  - Solar Thermal:
    - Water Heating
    - Pool Heating
    - Air Heating & Cooling
  - Passive Heating
- Solar is on the customer's side of the meter – thus it needs to be compared to the "price" of electricity and not the "cost" of electricity

Ontario Has The Solar Resource

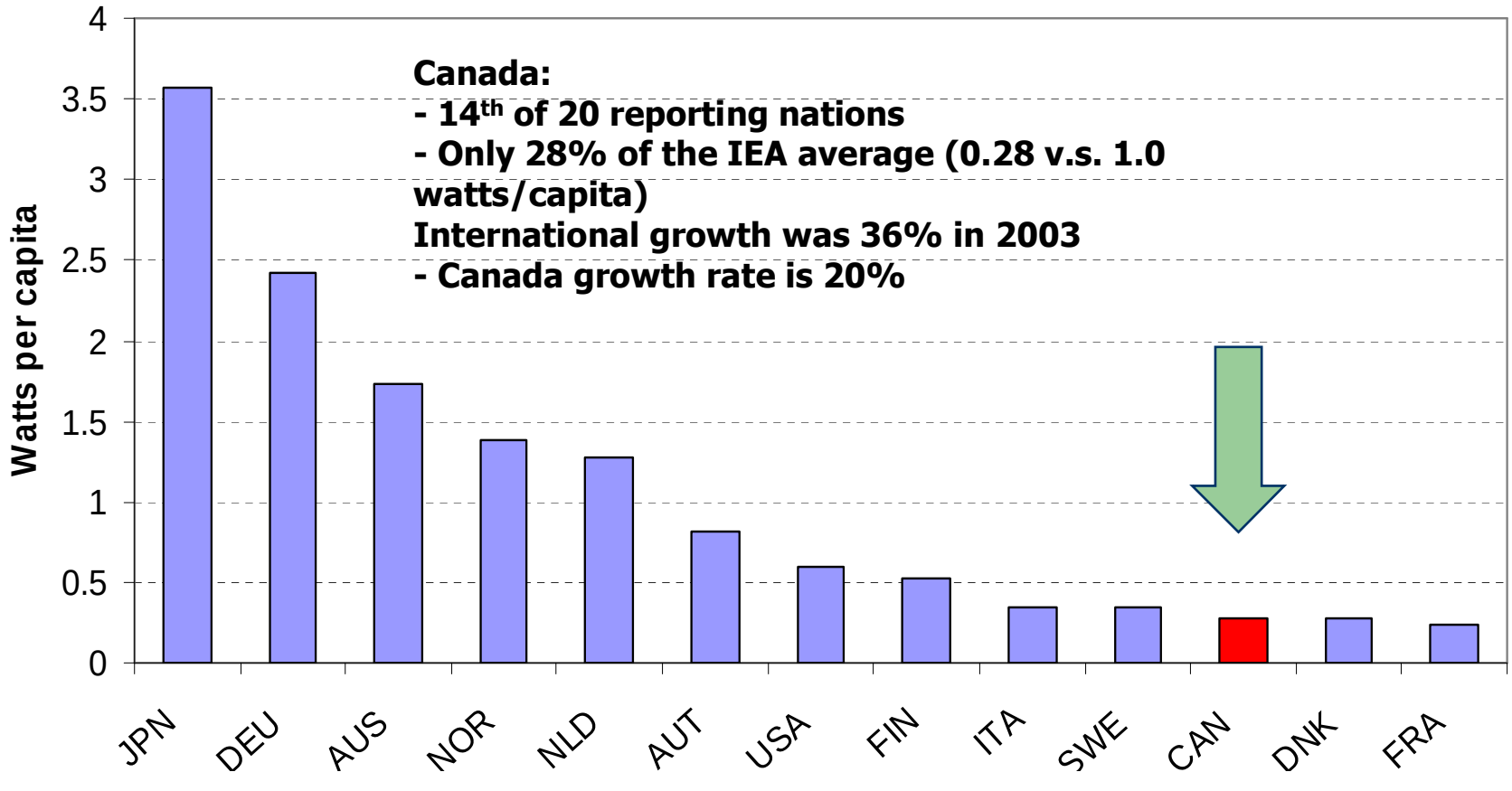


CanSIA

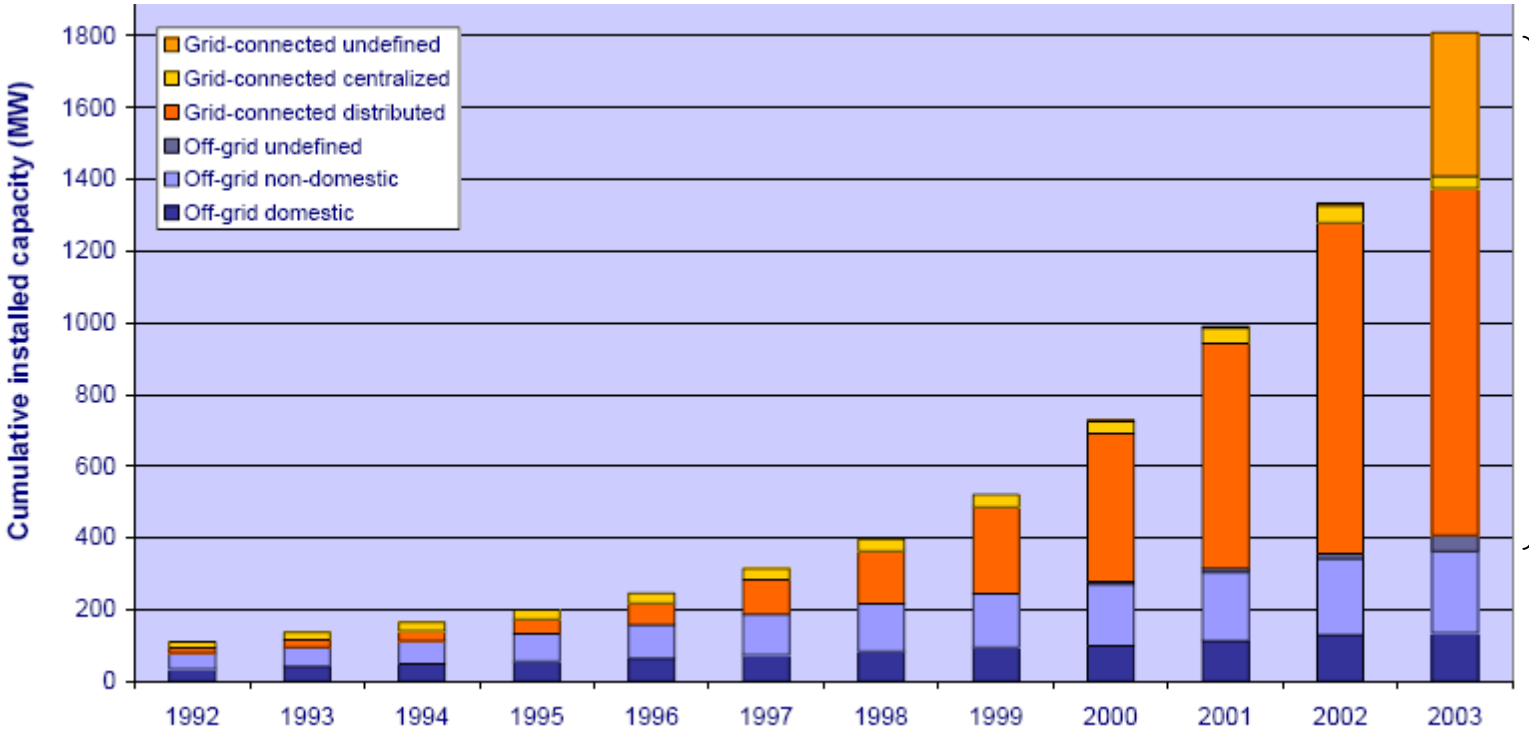
Solar Electricity - PV

Priming the Market

Canada Lags Other Nations



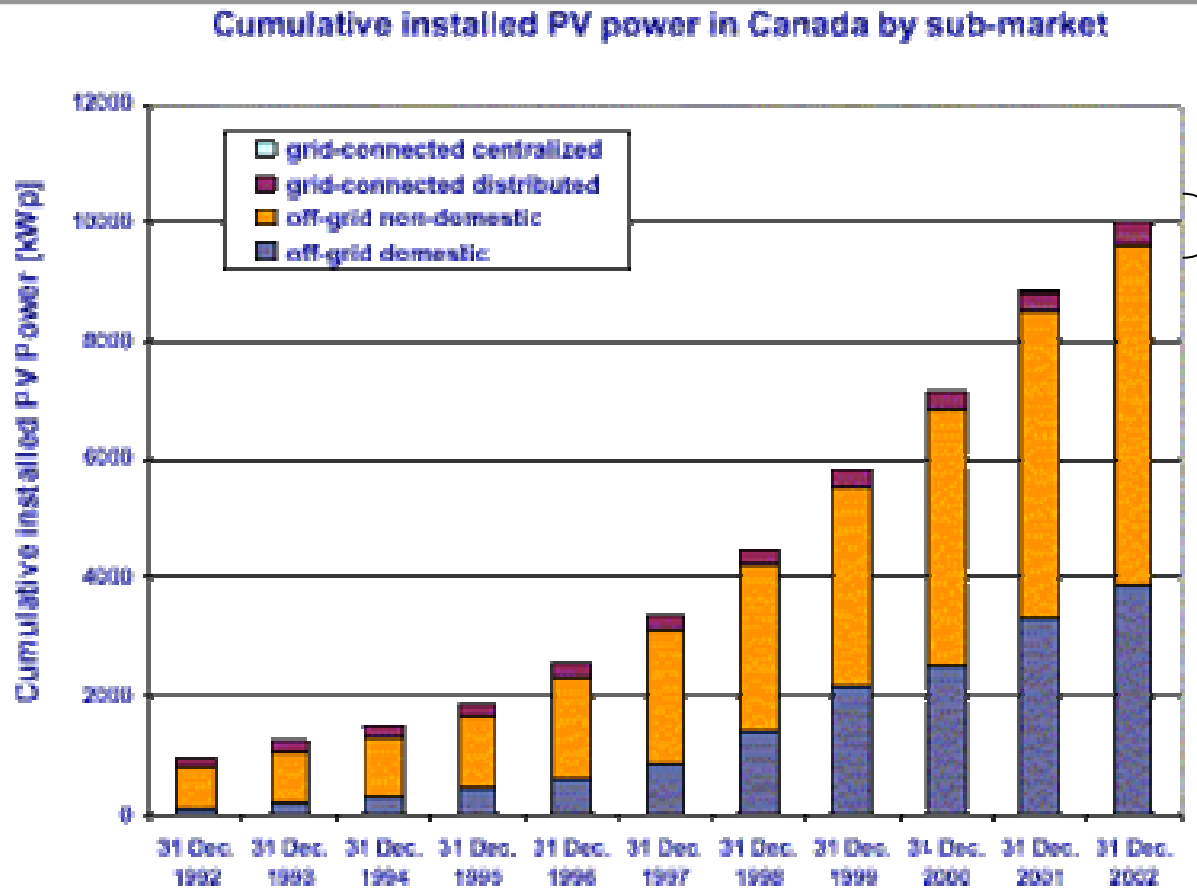
International Deployment of PV



78 % On grid

Source: IEA (www.iea-pvps.org)

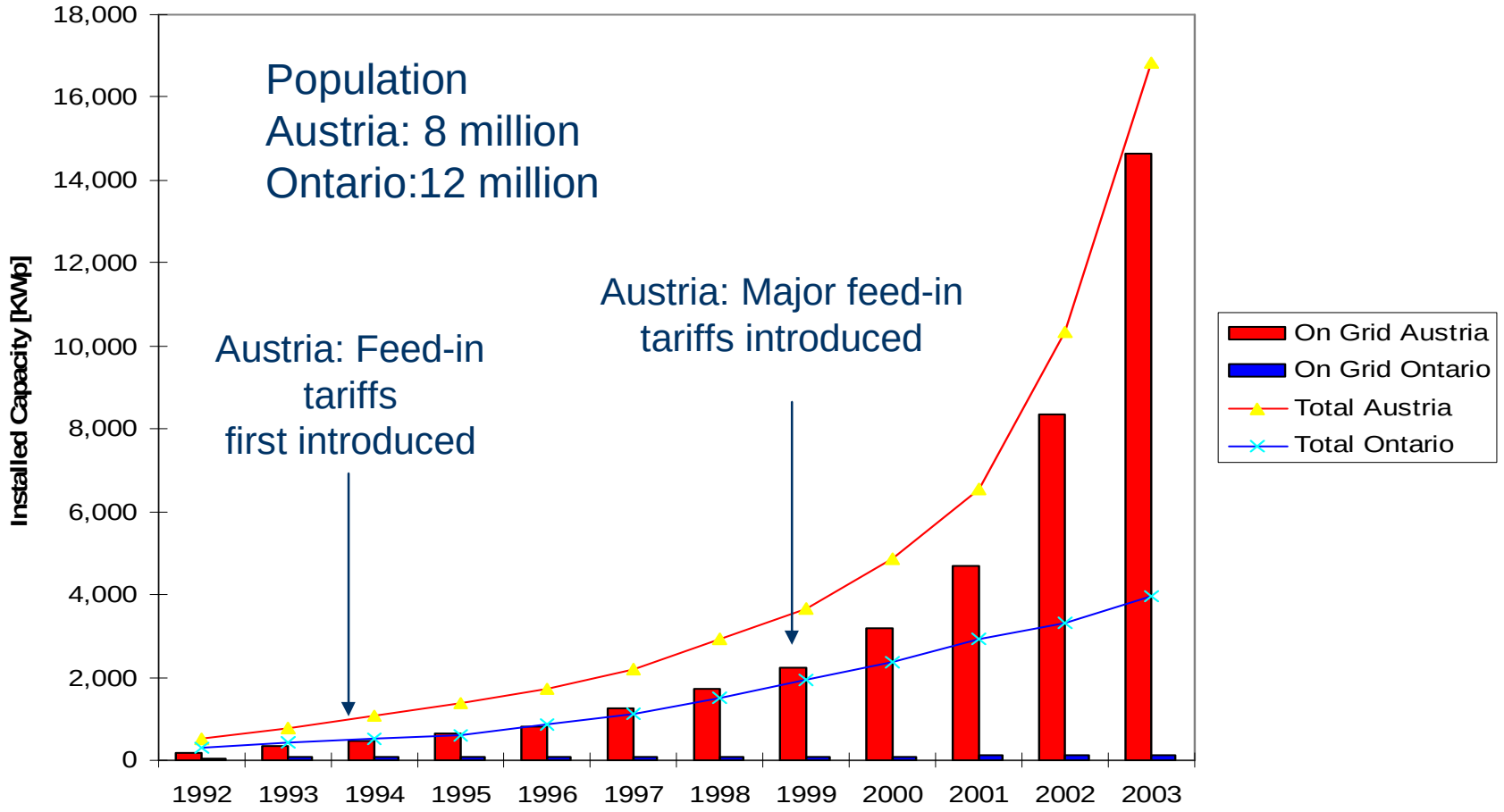
Canadian Deployment of PV



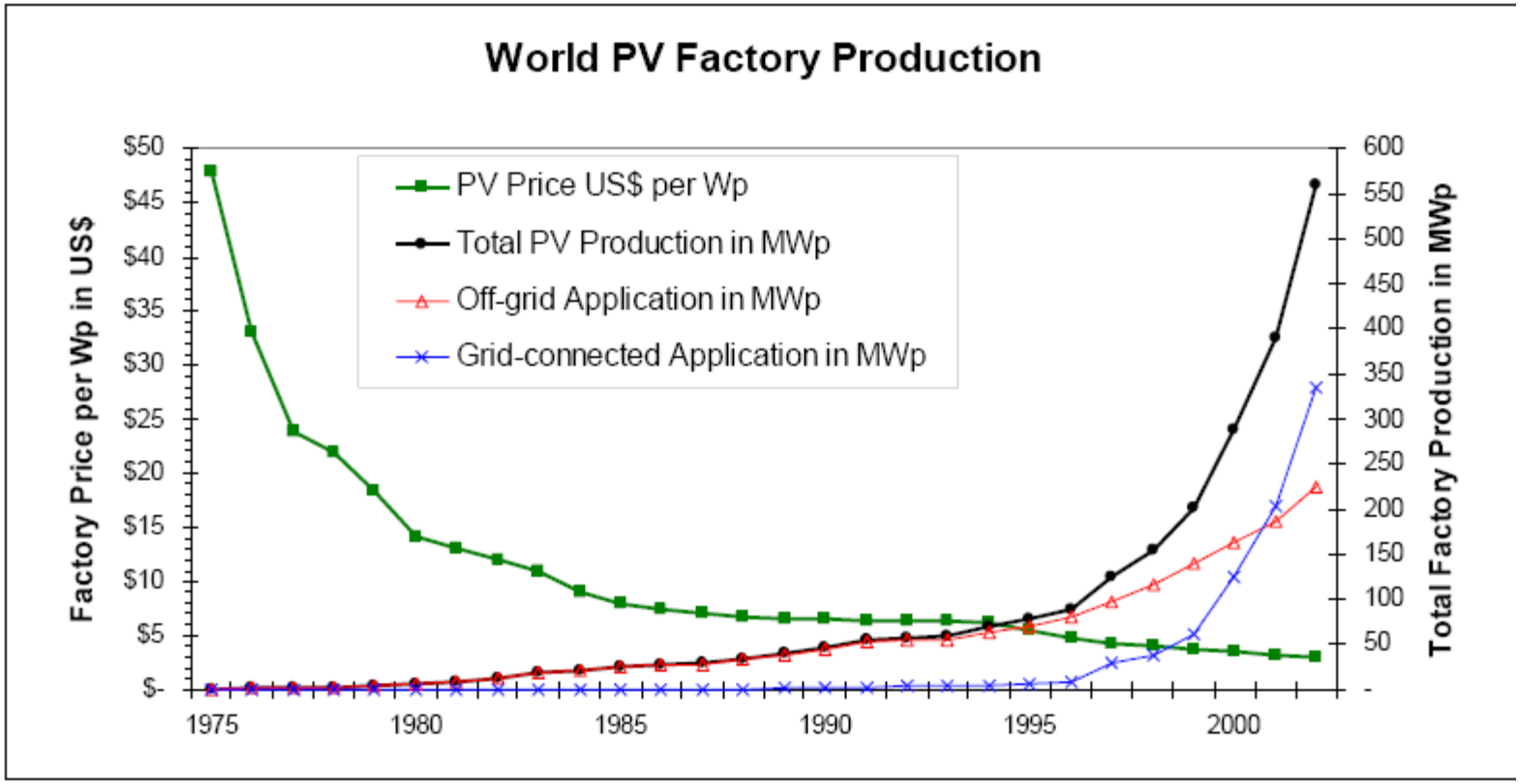
3.5 %
On Grid

Source: IEA (www.iea-pvps.org)

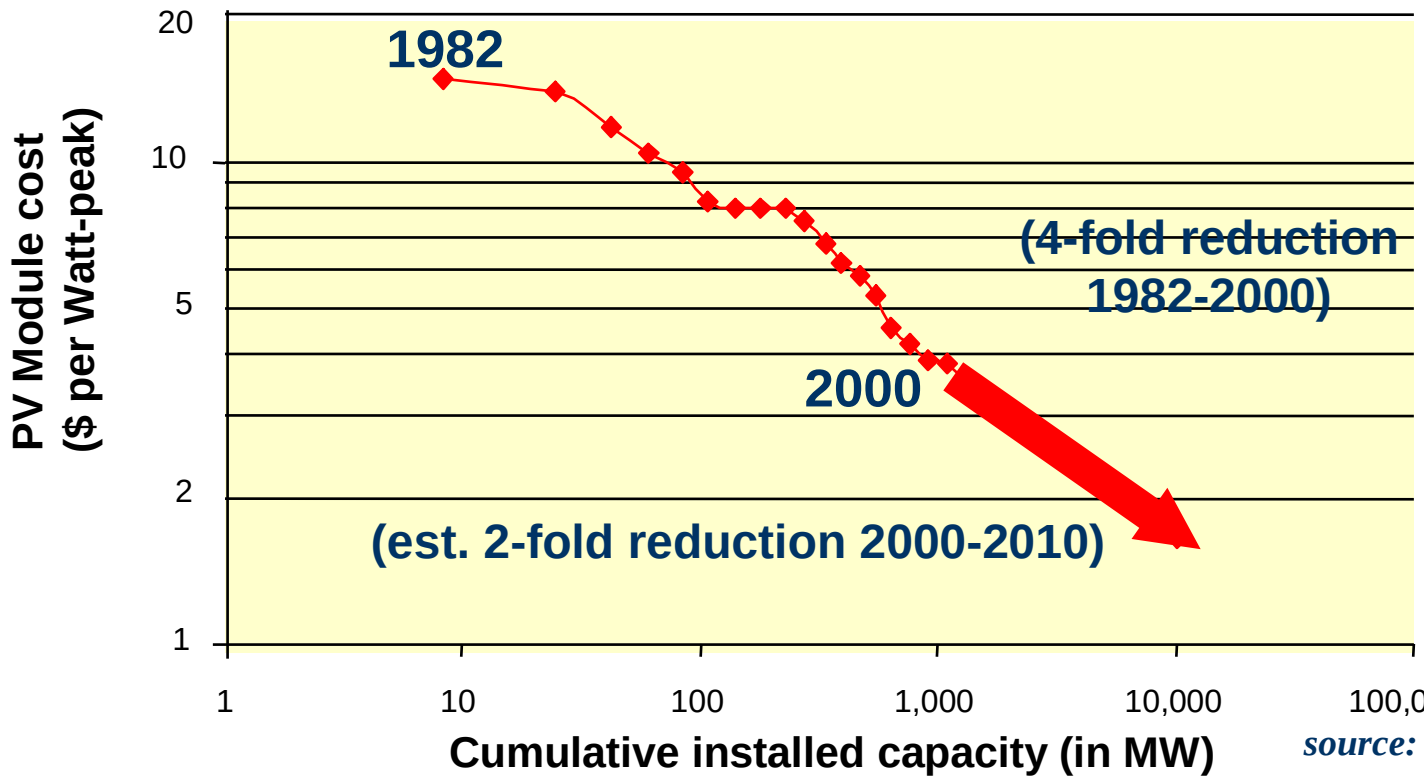
Comparing Austria to Ontario



Sales Climbing – Prices Dropping



The Price of Solar PV is Declining



source: Shell Solar

The Potential of PV on the Grid

- Potential Markets
  - Residential
  - Commercial/Industrial
- Residential has greatest potential as a first market based on international experience
- Now: 47% of all homes have the potential to install 3 kW PV array (3,000 MW now)
- By 2025: 2.5 million homes in Ontario will have the potential – 7,100 MW or 7,100 GWh
- Limit is the sustainable growth of the industry
- CanSIA believes that 400,000 PV powered homes by 2025 is an achievable target (1,200 MW)
- In Ontario – 2 mechanisms
  - Existing Homes – Standard Offer Contracts
  - New Homes - Net Zero Energy Home Initiative

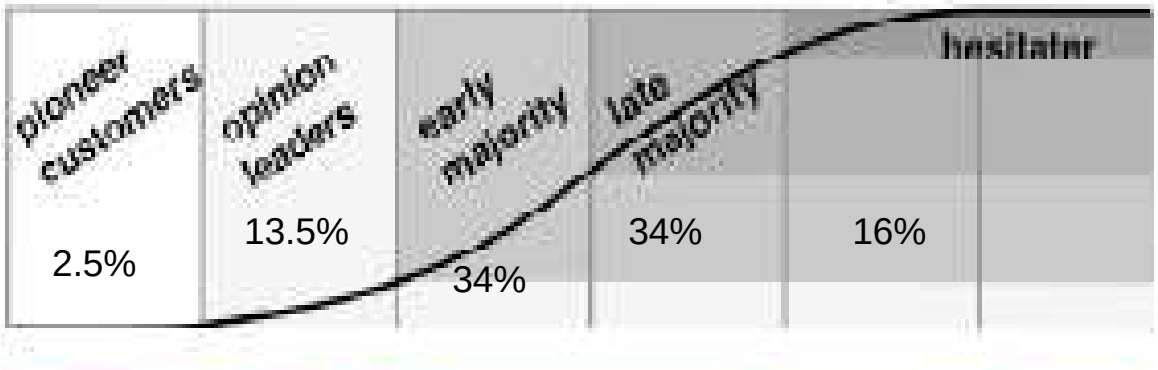
Growing the Market In Ontario

- Currently 50-60 systems (0.025- 0.1 MW) per year on-grid (many are guerrilla solar)
- Industry is small, under capitalized and working at low capacity
- Has the potential to grow at 50-75% initially
- Sustainable growth is 30-40% annually
- However German Market grew 87% in 2004 with sales of 360 MW
- Need to attract the “early adopters” first before opening the market

The First Market for PV

Targeting early adopters

- Assuming 2,200,000 homes in Ontario (2003), CanSIA identified 44,000 early adopters (2%). A succesful program would target 30%, thus 13,200



Source: Nordmann, T. (2003)

Benefits of Grid Connected Solar

- Fastest growing energy source in the world
  - jobs and wealth creation in Ontario
- The only electrical technology that is accessible to all of Ontario's homeowners
  - Leverage private dollars to put more generation on the grid
  - Stimulates energy conservation – "the more you save the more you make"
- Reducing Peak Demand
  - Solar generation occurs during peak period times – summer peaking loads
- Improving Grid Efficiency
  - Electricity is lost as it is transmitted from power plant to end user. Building the power plant at point of use avoids line losses
- Avoiding Upgrades to Transmission and Distribution
  - T&D is most heavily used during peak power demand. As solar is produced where it is used it avoids new T&D lines
- Green energy benefits

Quantifying the Benefits

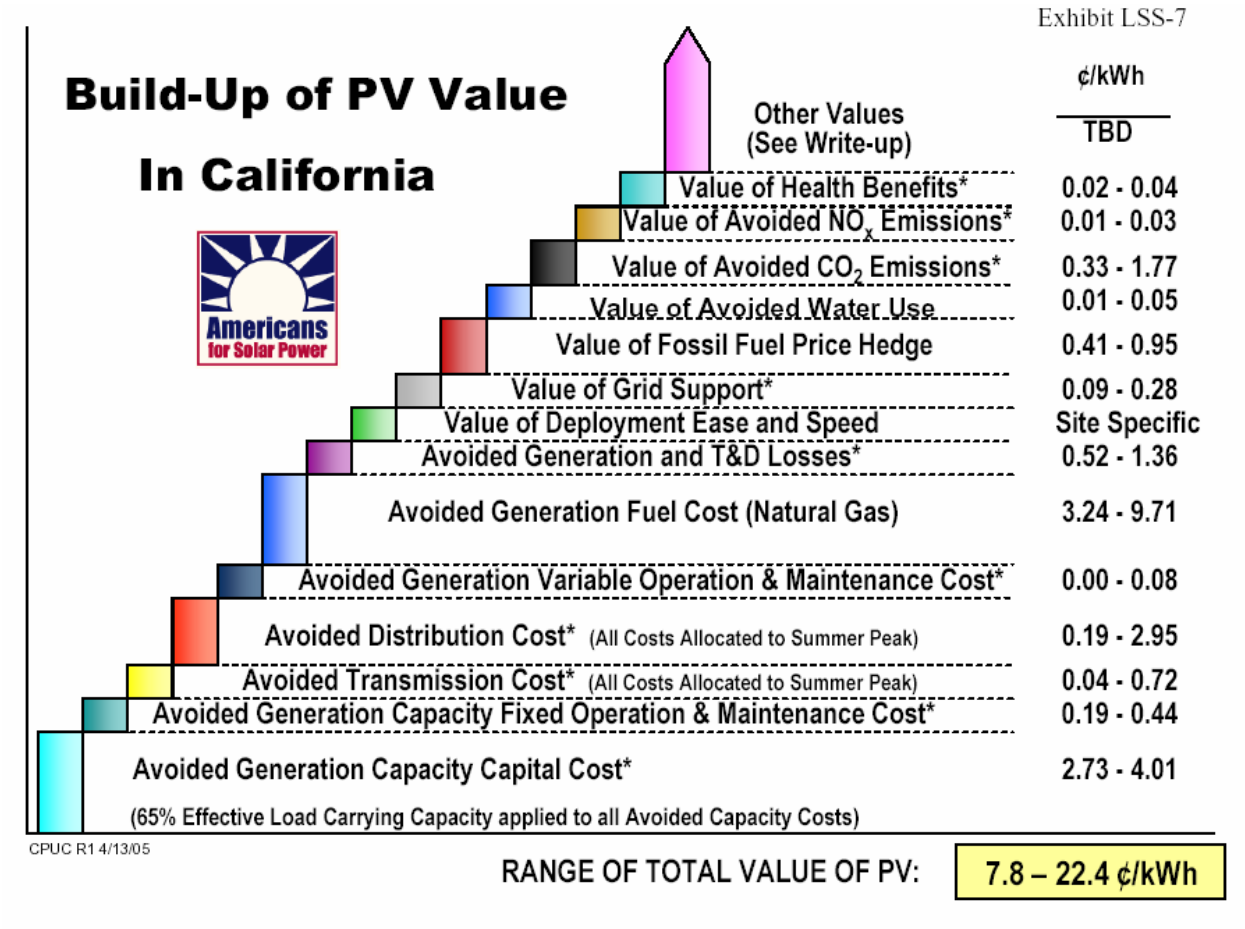


Exhibit LSS-7
Build-Up of PV Value
In California
Americans for Solar Power
¢/kWh
Other Values (See Write-up) TBD
Value of Health Benefits* 0.02 - 0.04
Value of Avoided NO_x Emissions* 0.01 - 0.03
Value of Avoided CO_2 Emissions* 0.33 - 1.77
Value of Avoided Water Use 0.01 - 0.05
Value of Fossil Fuel Price Hedge 0.41 - 0.95
Value of Grid Support* 0.09 - 0.28
Value of Deployment Ease and Speed Site Specific
Avoided Generation and T&D Losses* 0.52 - 1.36
Avoided Generation Fuel Cost (Natural Gas) 3.24 - 9.71
Avoided Generation Variable Operation & Maintenance Cost* 0.00 - 0.08
Avoided Distribution Cost* (All Costs Allocated to Summer Peak) 0.19 - 2.95
Avoided Transmission Cost* (All Costs Allocated to Summer Peak) 0.04 - 0.72
Avoided Generation Capacity Fixed Operation & Maintenance Cost* 0.19 - 0.44
Avoided Generation Capacity Capital Cost* 2.73 - 4.01
(65% Effective Load Carrying Capacity applied to all Avoided Capacity Costs)
CPUC R1 4/13/05
RANGE OF TOTAL VALUE OF PV: 7.8 – 22.4 ¢/kWh

Feed In Tariffs for PV – An International Perspective

- Feed In Tariffs were introduced by many nations in the 1990s
  - Germany introduced Feed In Tariffs in 1992
  - Many European nations including several American states followed
- Ontario has lagged other jurisdictions
- PEI has also announced intentions to introduce Feed-In Tariffs

Feed-in Tariff Rates in Other Countries

Country	Technology (in $CAN)				Contract Length	First Introduced
	PV	Wind	Hydro	Biomass		
Austria	$0.96	$0.125			13	1994
California	$0.667	-			3	1983
France	$0.245	$0.135			15	2000
Germany	$0.923	$0.140	$0.123	$0.185	20	1992
Italy	$0.804	-			29	1992
Spain	$0.676	$0.106	$0.106	$0.106	>25	1998
Portugal	$0.458	$0.161	$0.132		12	1998

PV Standard Offer Contracts For Ontario

CanSIA proposes:

- A feed-in tariff of $0.42 / kWh
- Program length of 10 years
- Contract length of 10 years
- Support level approximately 40% of system costs

• Benefit for the industry is the “selling“ period – not the contract length

• Rate needs to be set so that growth is sustainable – “overheating“ the market could create problems

Cost of Ontario Program

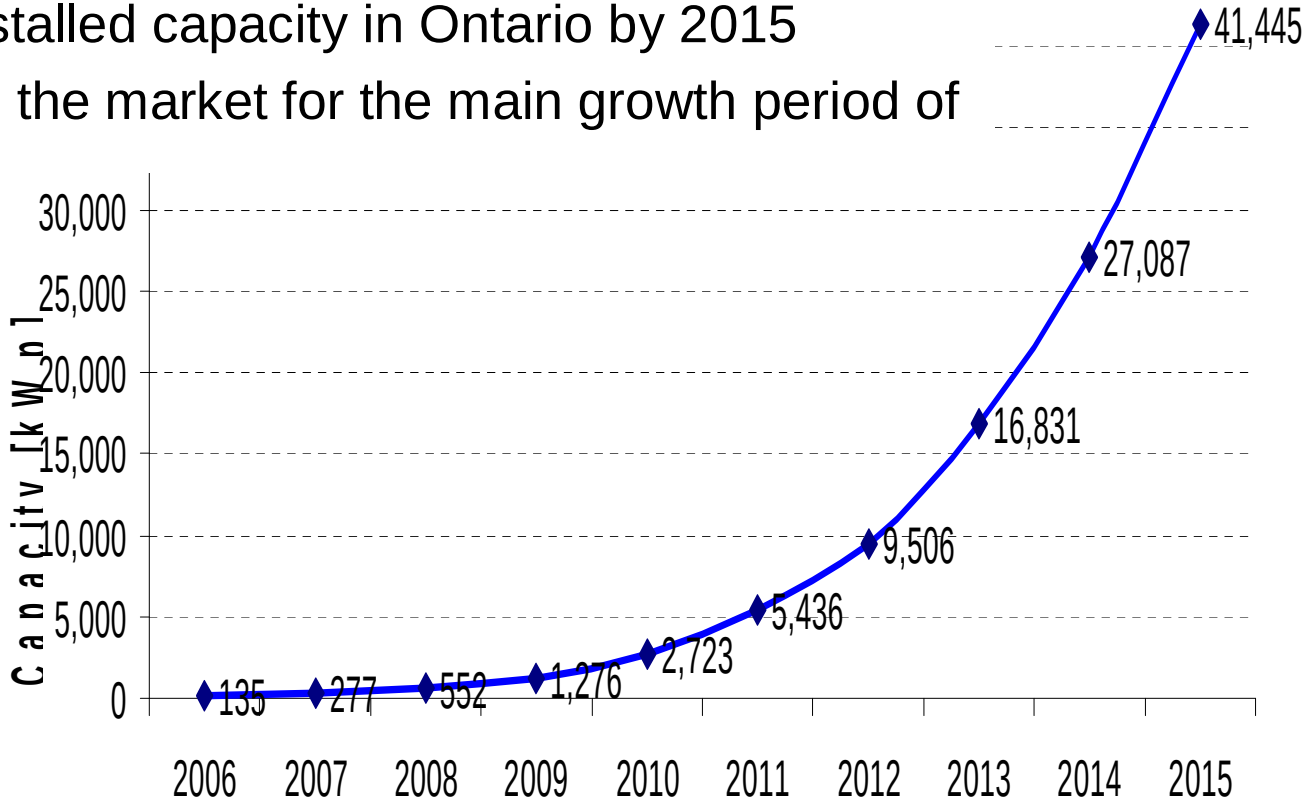
- Option: fund out of a public benefits charge
- SOC rate is not the subsidy rate or the price of PV electricity!
- The “purchased” electricity can be resold to the consumers, probably with a higher than retail price as it is “green”
- If spread over the ratepayer base:

$0.70/ year for an average household (25 kWh/day)

“Less than a candy bar”

Growing the Market in Ontario

- A 10 year program would lead to **15,000 systems** or **40 MWp** installed capacity in Ontario by 2015
- This primes the market for the main growth period of 2015-2025



CanSIA

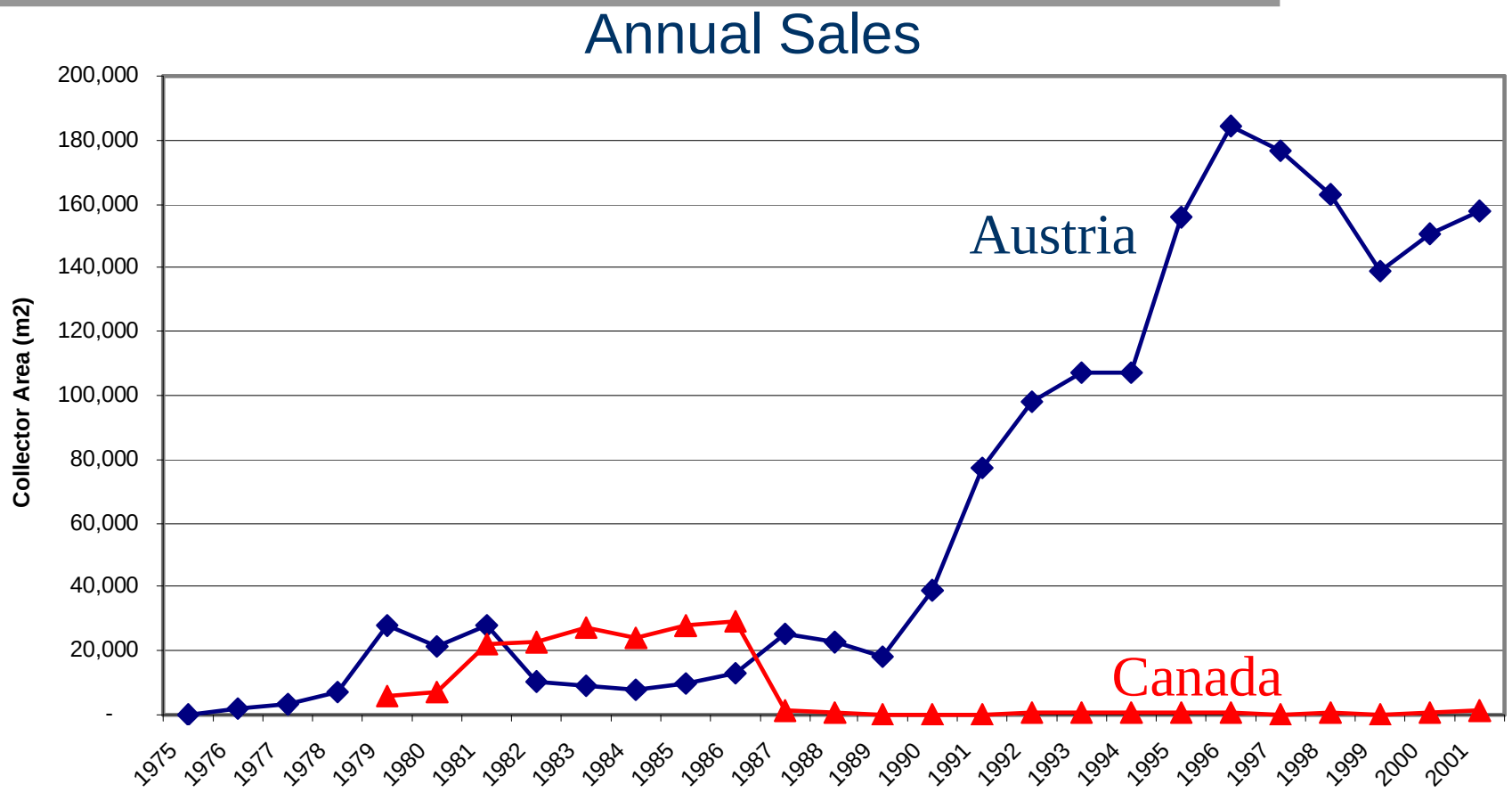
Solar Hot Water

Overcoming the financing barriers

Solar Heat in the World

- Canada once the world leader (1980s)
- Abrupt cancellation of programs lead to bankruptcy of 80% of solar companies (86-89)
- Canada now ranks 16th out of 26 IEA reporting nations with only 12% of the average per capita sales
- Canada is falling further behind each year
- World leaders include Israel, Greece, Austria, China

Solar Hot Water – Austria & Canada



Solar Hot Water Facts

- SDHW systems provide 50% of the annual load
- Provides 100% of load during peak summer periods
- Typical SDHW system is 4-5 kWt
- Average installed price is $3,000 - $4,000 ($600-$1,000 per kW)
- Typical electric water heater is 4-5 kW
- Water heating accounts for 25% of a homeowner's energy demand (all other non-space heating electrical loads are 25%)

Solar Heat Potential in Ontario

- Energy demand in Ontario (non-transportation) is:
  - 75% heat & 25% electricity
- Electricity is used for heat (water heating) and cooling (absence of heat)
- 74% of homes can install a Solar Domestic Hot Water (SDHW) System
- Homeowners (single family) – 2,200,000 homes – 21% with electric water heating
  - Historically use of electric water heating is dropping – projected to be 10% by 2025 – potential is 800,000 SDHW systems – 80,000 displacing electrical heaters
- Social Housing
  - Typically 40-50% use electric water heats
  - Major benefits in using solar
    - Reduces operating costs for the corporation
    - Reduces rent (and decreases rent increases) for fixed income residences
    - Note that the the Social Housing Services Corporation is calling for a 10,000 m^2 (7 MWt) 10 year program

Accounting for the Costs of Solar Hot Water

- Solar DHW – Different ways of accounting for the cost:
  - Payback: 7-12 years
  - Return On Investment: 8-14% (bonds are at 4%)
  - Energy Cost – 5-7 cents per kWh
- Challenge is to provide a means in which the costs can be accounted for as an investment or similar to central power generation

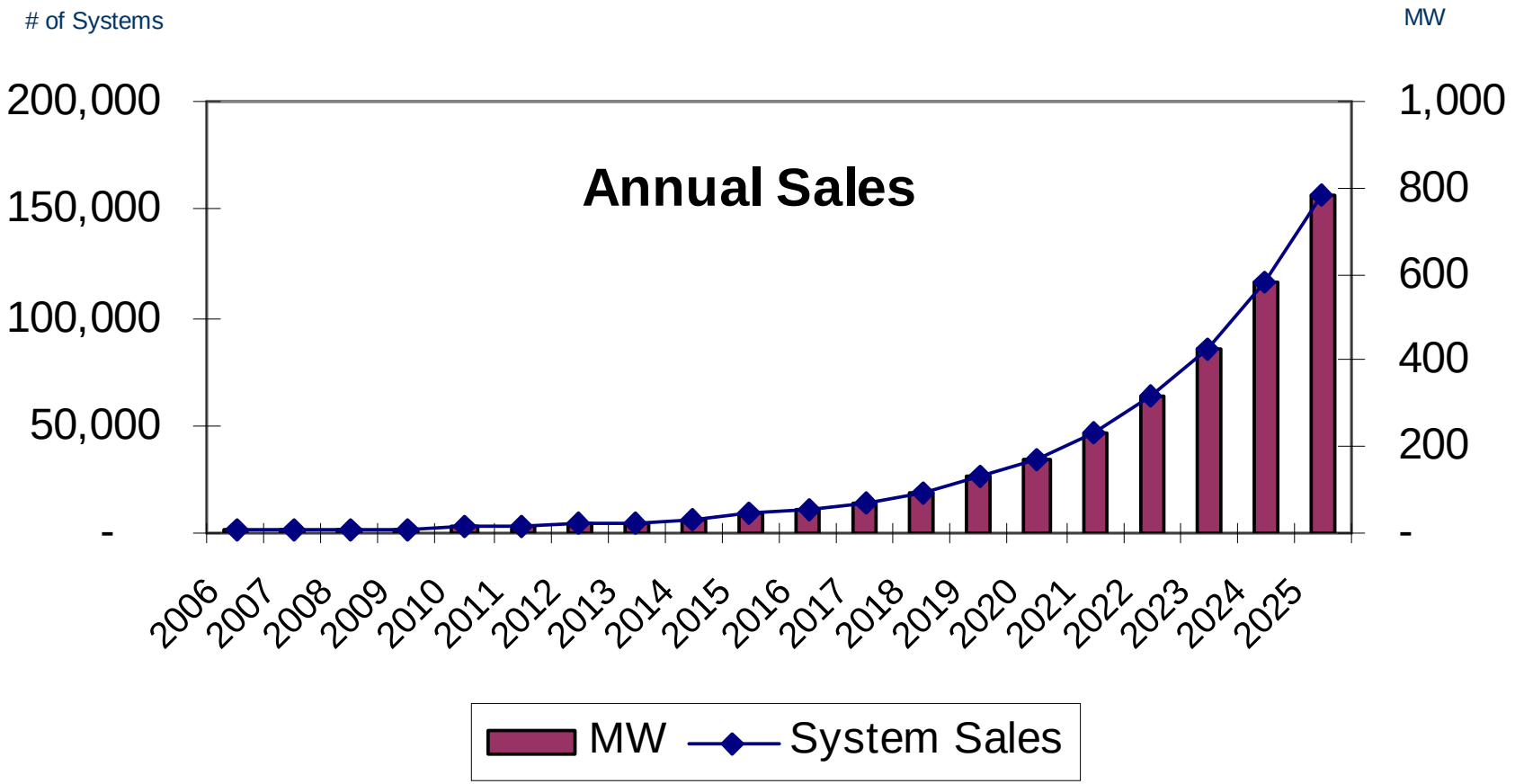
Financing Purchases

- Concept – spread the cost over an extended period
  - Monthly payments are less than monthly savings
  - Immediate payback
- Challenge
  - No mechanism in the marketplace for small generators (homeowners, etc) to obtain the same financing rates as large central power plants
- Results
  - Financing costs eat up the economics
  - “Solar Bank” concept is unknown in Canada (but popular around the world) – financers view this “unknown” as a risk
- Solution
  - Subsidize the interest rates – and not the capital cost

Solar Financing in Ontario

- Start small – 1,000 systems over 2 years
- Grow sustainable over 5 years
- Bring in private investors/financing as confidence grows
- Term loans:
  - 10 years
  - Low interest rate 0-4%
- Cost of support is less than $150 per kWt

Leading to Long Term Growth



Solar – Huge Potential

- Solar Technologies (PV and SDHW) have huge potential for electrical energy generation and reduction in demand
- Base is small so impact is not immediate
- Impact begins in the 2015-2025 period. By 2025:
  - PV – 400,000 homes – 1,200 MW – 12,900 GWh
  - ST – 800,000 homes – 3,200 MWt – 1,400 GWh displacing electricity
- Need to begin building the infrastructure and capacity now
- Waiting till solar is “ready to make a difference” delays the benefit

Solar – The Timing is Right

- Reason for success is there is public acceptance – consumers are willing to pay for green energy as a societal benefit
- Priming the market now means that solar will be prepared to contribute in 2015-2025 period when its price will be competitive
- Time is right for Ontario to go down this path

Contacts

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Canadian Wind Energy Association

Association Canadienne de l'Énergie Éolienne

CanWEA Perspectives on Ontario's Future Electricity Supply Mix

OPA Stakeholder Consultation

September 22, 2005

In collaboration with Helimax Energy

CanWEA

- National industry association
- 200+ corporate members (developers, manufacturers, utilities, service providers)
- Develop and advocate industry positions on key policy issues relevant to the industry
- Believe wind energy can make a much more significant contribution to Ontario's future electricity needs than currently contemplated – we need to "Think Big"

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Supply Mix – Strategic Considerations

- The following strategic factors must be considered in making decisions about Ontario's future supply mix:
  - Resource availability
  - Economic costs and benefits
  - Environmental performance / social acceptance
  - Synergies with existing system needs
  - Reliability / Safety
- Wind energy stands up well against these criteria and should play a significant role in providing clean, reliable power to Ontario

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Potential for Wind in Ontario

- Almost 33,500 MW of wind energy potential above 6.5 m/s within 25 km of transmission lines
- Almost 400,000 MW of wind energy potential above 6.5 m/s in the province
- A good wind potential is situated in southern Ontario - in proximity to the large load centres
- Geographic dispersion of the wind resource reduces the need for interconnection or transmission line upgrades.
- Good distribution of projects reduces variability of the overall energy yield (by 60-70%).

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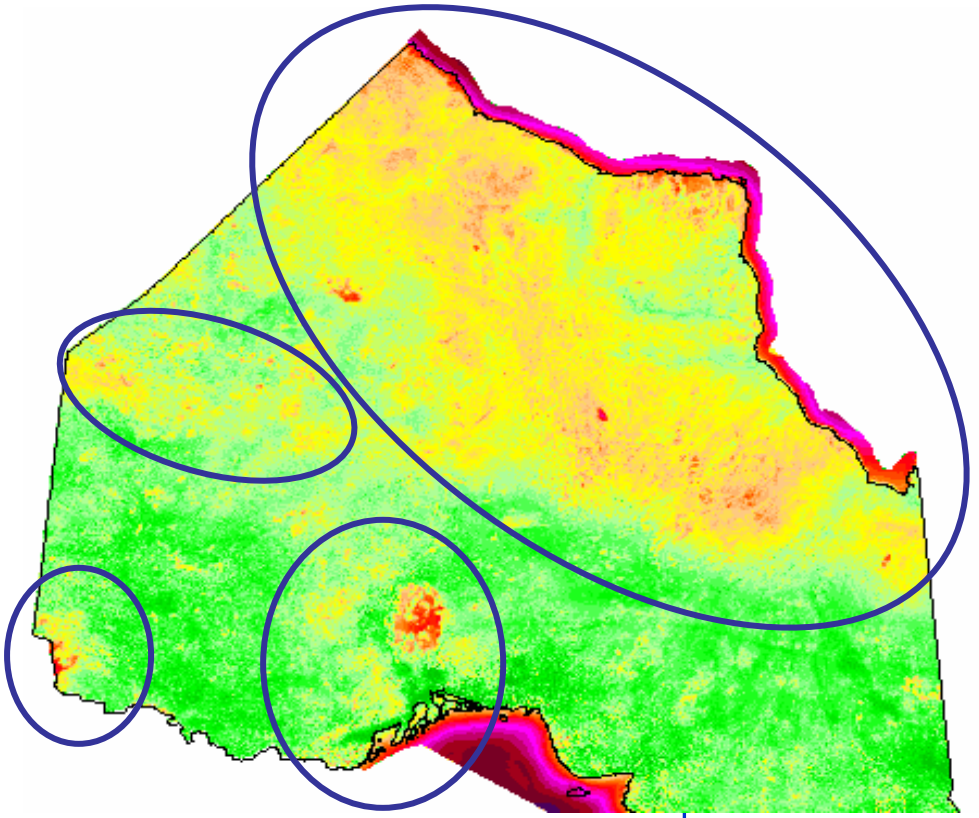
Potential for Wind: Northern ON.



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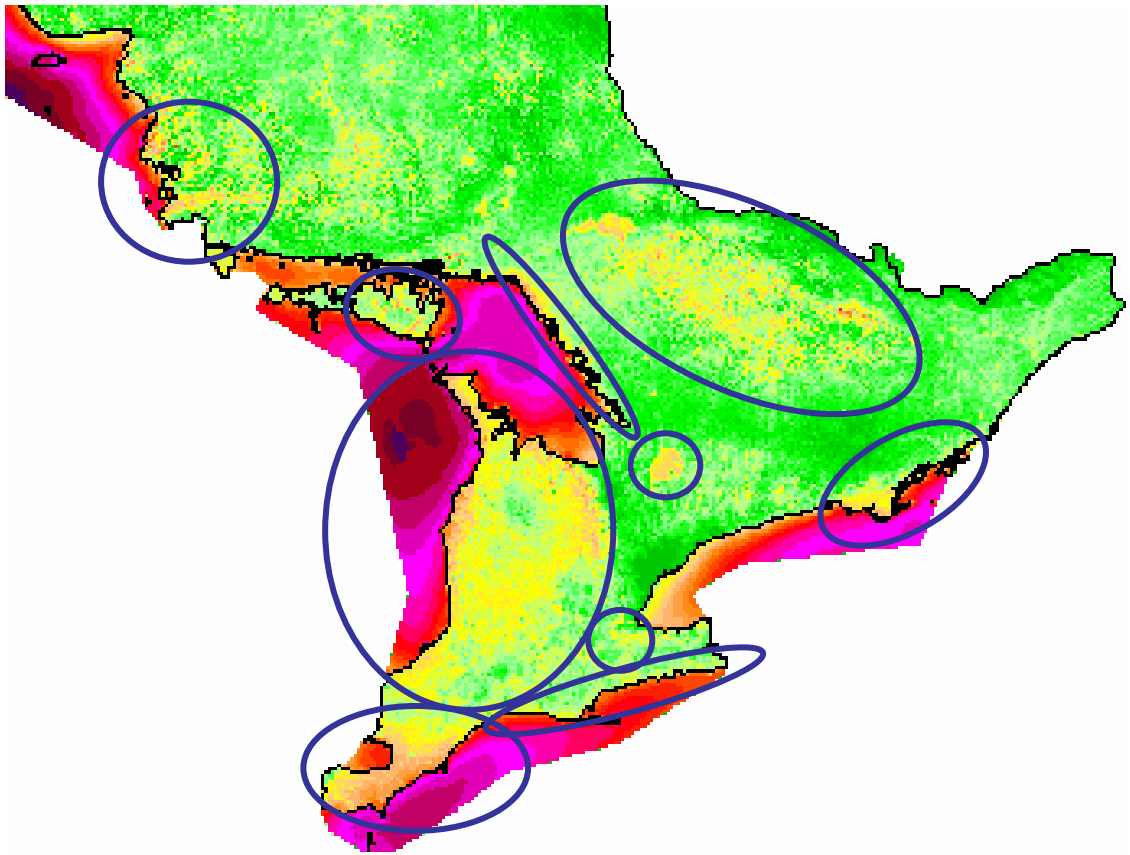
Potential for Wind: Southern ON.



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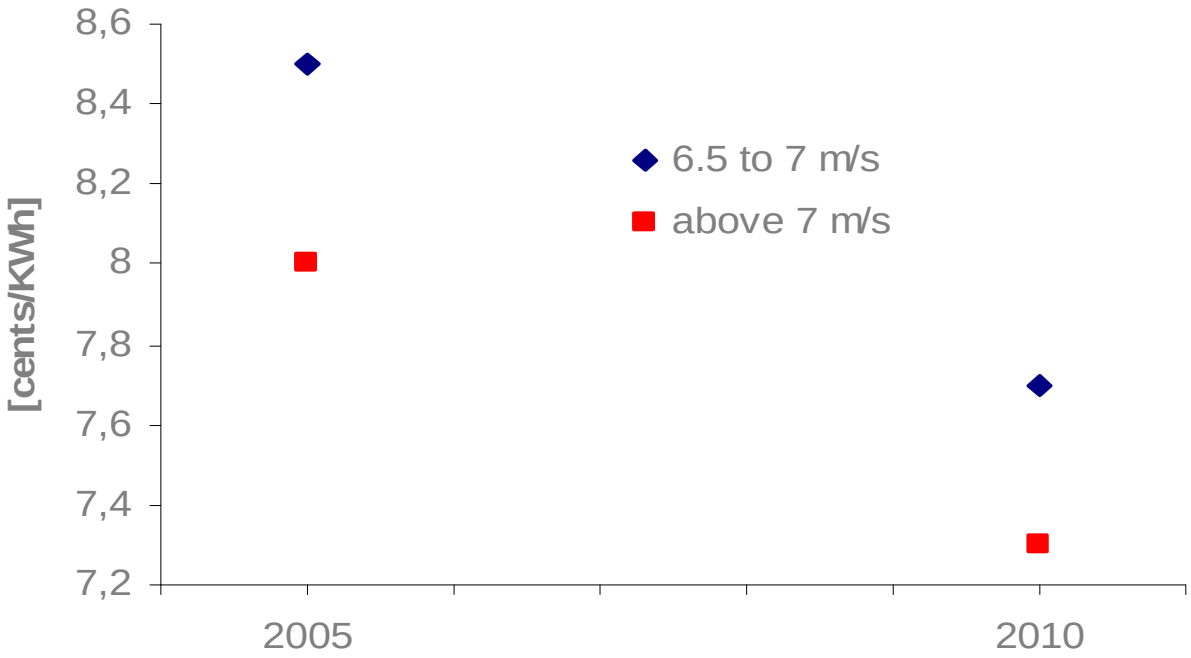
Cost of Wind Power (1)

- Wind is competitive with other energy sources in Ontario
- Increased value because of cost certainty



- Wind power costs between 8.0 and 8.5 cents per KWh with wind speeds at 6.5 m/s

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Cost of Wind Power (2)

- Short-term cost increase (exchange rates, steel prices, tight market for turbines, learning by doing)
- Well accepted that costs will decline significantly over time
- Economic benefits for local communities, particularly in rural areas (land lease payments, municipal taxes, construction, operations and maintenance)
- Potential to increase economic benefits to Ontario with domestic turbine / component manufacturing

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Siting of Wind Turbines

- Polling data shows very strong public support for wind energy development in Canada
  - 96% support continued development
  - 92% support the development of a project for their community
- Vast majority of proposed wind energy developments in Canada have received strong community support
- Many municipalities and community based organizations (e.g., OSEA) seeking wind energy development
- Proactive community engagement and the provision of quality information is critical to addressing siting concerns – CanWEA active in this area

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Connecting Wind

- Need to evaluate:
  - distance between wind resource and grid
  - ability to interconnect high wind speed areas & grid (southern & northern Ontario)
- Analysis conducted for RFP II indicated that at least 5,000 MW of renewable energy could be reliably integrated without significant upgrades to the transmission system
- Greater amounts of wind may require new investment – the wind resource must be considered in future long-term transmission planning
- CanWEA believes proponent-led, rate-base supported, transmission upgrades can provide more flexibility in the short-term

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Integration of Wind

- According to different U.S. studies:
  - At low penetration rates only US$ 3 to $4 per MWh for integration of wind
  - At penetration rate of 20%, US$ 5.5 per MWh
- CanWEA study done by AWS TrueWind showed:
  - Increased operating reserves for 2,000 MW of wind is 10% of installed wind energy capacity
  - Capacity value of wind is high – around 30% (46-47% in winter – 18-19% in summer) – Ontario is still a winter peaking (seasonally) jurisdiction

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Benefits of Wind

- Zero emissions and overall low environmental impact
- High public acceptance
- Diversification of the supply mix, benefits of distributed generation
- Energy security by eliminating dependence on imports
- Modular and rapid to install
- Creation of employment, regional growth
- Provide hedge against the volatility of fossil fuel prices
- Fuel is free, abundant, and inexhaustible
- Reliability rate of 95 to 98%

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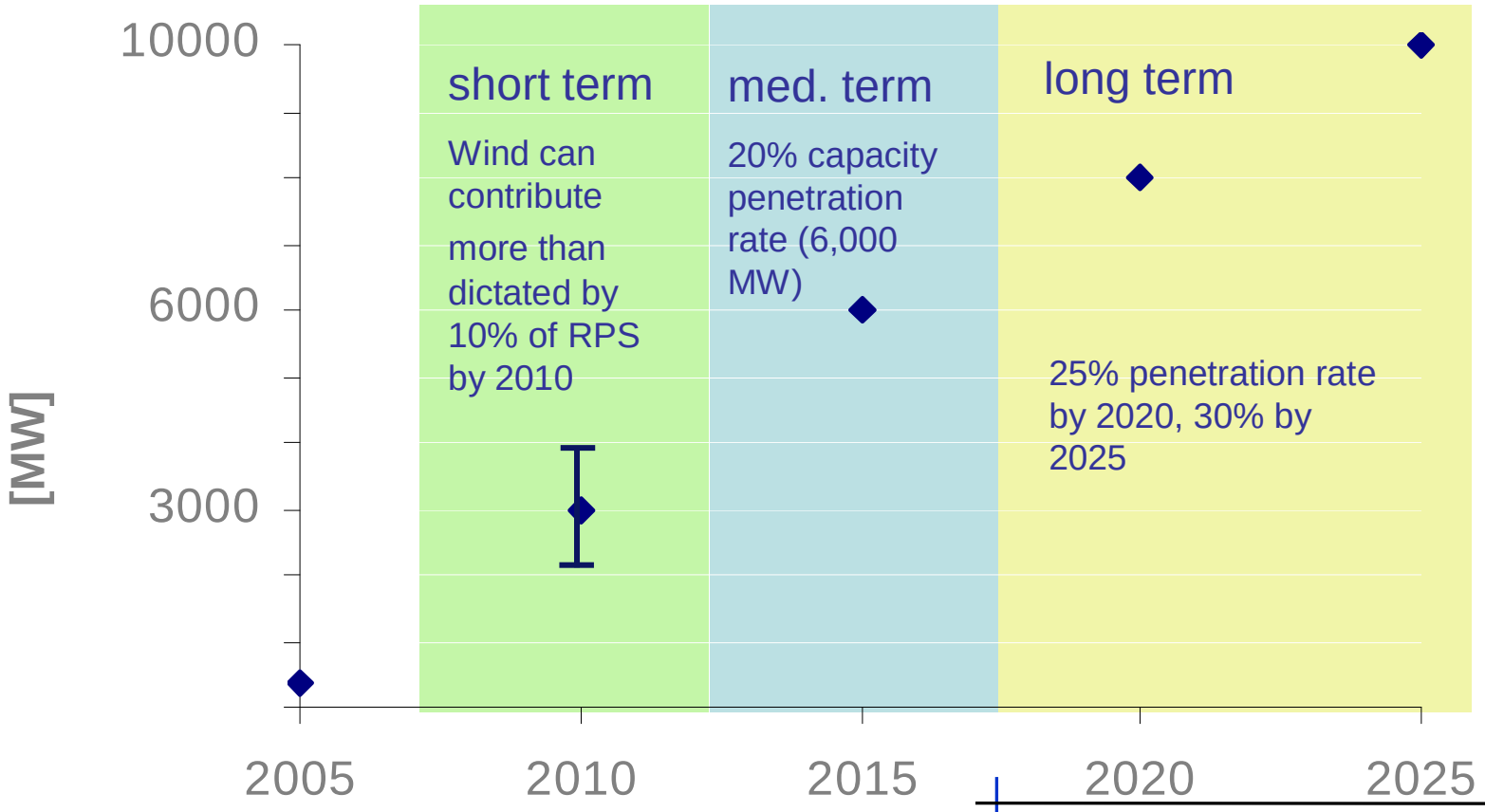
Recommendations: Targets



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Recommendations: Wind

- Maintain commitments to phase out coal fired generation
- Show government commitment to wind power as means to meet environmental requirements
- Ensuring financial, fiscal and energy market structures do not create barriers
- Address interconnection constraints / barriers
- Ensuring future procurement processes do not create barriers
- Ensuring that all required provincial and municipal approvals are streamlined.

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EDA
The Voice Of Ontario's Electricity Distributors

EDA Comments on OPA Supply Mix Issue

EDA Presentation

October 4, 2005

OPA Supply Mix Consultation

- EDA asked by OPA to discuss the role of LDCs in Ontario's future "supply mix". Focus on
  - Insights on conservation and demand management and distributed generation
  - Role of LDC in supply/demand planning/ implementation
  - Issues and concerns related to Ontario's electricity supply mix

EDA Presentation Outline

- Stable regulatory framework for the delivery of CDM is needed
- LDCs should continue to be taking the lead role in CDM with the OPA providing assistance
- OPA should assist LDC in addressing existing barriers to CDM – address outstanding policy issues
- OPA role in CDM
- Distributed Generation

Stable CDM Regulatory Framework

- LDCs have experienced considerable regulatory uncertainty regarding their CDM role
- Early 1990s virtually all DSM programs were cancelled
- Last year's debates at OEB on LDCs vs Central Agency delivery of CDM
- Some stakeholders still advocating for strong central control of CDM
- Government has made a clear decision to have LDCs take the lead role in CDM delivery

Stable CDM Regulatory Framework

- Any uncertainty re role of LDCs in CDM may discourage establishing CDM as a core part of their business
- OEB's decision on the 2006 Electricity Distribution Rate Handbook clarified LDCs can file for more funding towards CDM programs
- Any further policy changes should build on what has already been established in order to reduce regulatory uncertainty
- OPA should incorporate in its plans that LDCs will continue to have lead role in delivery of CDM

Outstanding CDM Policy Issues

- Unequal treatment between CDM and renewable generation, where renewables are receiving a premium above avoided costs.
- Tracking CDM results of 3rd parties delivering CDM in LDC service territories
- Existing LDC rate design that discourages untrackable energy savings

Value of CDM Vs Renewables

- CDM is valued at avoided costs of generation, transmission and distribution (OEB's TRC Guide Appendix C)
- CDM is valued on avg. at approx. 7 cents/kWh
- Renewable Power is valued at approx. 9 - 11 cents/kWh
- What is the rationale for the different values?

Rationale for Renewable Generation premium

- Concern on “real results” from CDM initiative which suggest discounting system benefits
  - uncertainty of the magnitude of CDM results
  - uncertainty whether early results will be sustained – see OPA’s Interim Report – Summary of What We Heard in OPA’s Generation Procurement Stakeholdering Sessions

Response to discounting value of CDM

- Not appropriate to discount avoided cost estimates to account for uncertainty associated with CDM savings estimates
- CDM uncertainty should be addressed through
  - thorough review of CDM programs
  - proper selection of measurement methods of load reductions and persistence
  - application of effective measurement and verification protocols

Avoided Environmental Damage Costs

- California Public Utilities Commission includes the value of avoided environmental costs in TRC analysis
- OEB “recognizes the benefits associated with avoided environmental damage are real.”
- “It has not been the practice of parties before the Board to include these benefits.”
  - See OEB’s Views on Stakeholder Comments on the draft Guide to Total Resource Cost Analysis

More equal treatment between Renewable Generation & CDM

- EDA supports equal valuation between Renewable Generation & CDM
- Government has set targets for renewables with RFPs selecting projects with lowest cost to meet targets, with resulting prices above avoided costs
- This implies that 5% target by 2007 for CDM could be achieved through RFP approach with costs for projects up to renewables

3rd parties delivering CDM in LDC service territories

- Non-rate regulated third party delivered CDM involving local LDC, LDC allowed to claim 100% of the CDM results
- Third party delivered CDM not involving local LDC, delivered in the LDC's service territory, LDC cannot claim the results and is not protected against lost revenue.
- OPA may fund third party delivery of CDM programs province-wide

How to protect LDC from 3rd party CDM programs

- LDCs involve third parties in CDM programs by contracting out, joint promotions, etc
- OPA province-wide CDM programs, by design, should involve local LDCs (funding, assist in delivery, promotion etc)
- Third parties using any provincial funding should be required to contact & involve local LDCs

Conflicting Goals of LDCs

- LDC act as local agents to promote conservation culture
- LDCs need to adopt a corporate culture of conservation
- LDCs rely in part on variable distribution charges to recovery revenue requirements
- Conflict between relying on recovery of revenue requirement through electricity sales and encouraging customers to conserve/ making conservation core business

CDM Mechanisms do not entirely protect LDCs

- LDCs have lost revenue adjustment mechanism (LRAM) and shared savings mechanism (SSM) to keep LDCs whole and receive financial rewards for results
- BUT CDM results must be measured & audited
- LDCs are at risk for load reductions that are caused by CDM programs but not measured
- If LDCs are successful on changing consumer behavior through conservation messaging, LDCs lose revenue

Rate Design Solution

- Fixed costs of distribution recovered in part through variable charges
- Residential rates with kWh charges create a disincentive to promote energy savings that cannot be tracked
- OEB indicated a comprehensive study of distribution rate design would start in 2006
- EDA is seeking a rate design that would address the conflicting goals by recognizing the fixed costs of distribution

Implications of Reflecting Fixed Cost in Rate Design

- Implementation of smart meters allows more options for designing distribution rates e.g. kW charges for all customers
- Use of demand charge (peak demand in month) should be more revenue stable
- Use of higher customer charges would be very revenue stable - issue of customer acceptance

OPA Role

- Should act as enabler of LDC CDM programs
- Could provide templates of programs
- Can serve as clearing house of information
- Can assist in developing measurement and verification protocols
- Can provide model contracts for 3rd party CDM
- Can focus on CDM programs LDC cannot achieve on own
  - e.g seeking higher efficiency though changes to standards and codes

Ministry asks for Standard Offer Contract Proposal

- August 19 MoE asks OEB & OPA to

  - address the barriers to small generators through use of standard offer programs

  - develop the terms and conditions for a program for small renewable generators

- OEB to focus on necessary changes to codes and connection requirements, and non-discriminatory access to the electricity system
- OPA to focus on appropriate price and eligibility requirements to qualify for the standard offer program
- Minister seeks report by year's end

  - findings, recommendations and proposed implementation plan

Rationale for Standard Offer Contract

- Provide standard price through long term contracts to all eligible small renewable distributed generation
- Small renewable generation cannot afford administrative burden of RFP process, and cannot compete with larger projects

Policy Rationale

- Small embedded renewable generation will
  - typically reduce line losses, increase system stability
  - increase local rural investments
  - obtain greater public acceptance of renewable generation
  - help meet renewable targets
  - possibly help in attracting new manufacturing

OSEA Report

- Ontario Sustainable Energy Association (OSEA) issued report in May 2005
- “Powering Ontario Communities: Proposed Policy for Projects up to 10 MW”
- OSEA report was commissioned by Ministry of Energy

OSEA Recommendations

- Projects Size – up to 10 MW, connected at distribution
- Eligible projects – wind, small hydro, biomass, solar PV
- Eligible participants – farmers, rural landowners, community organizations, co-ops, NGOs, municipal entities, small businesses, private individuals
- Contact term – 20 years, extension at end
- Interconnection –
  - guaranteed right of interconnection with simple terms
  - 90 day application response from LDCs
  - project responsible for costs to point of interconnection
  - network upgrades borne by system

Standard Offer Price

- OESA recommends fixed price – based on technology
- Wind power years 1-5: 13.3 cents/kWh
- Wind power years 6-20: 6.9, 9,13.3 cents /kWh depending on wind experienced in first 5 yrs
- Small hydro: 13.3 cents/kWh
- Biomass:13.3 cents /kWh

EDA DG Policy

- EDA supports the encouragement of Distributed Generation ("DG")
  - reduce system losses
  - reduce the need for additional infrastructure when located close to loads.

LDC concerns regarding DG

- When a DG proponent approaches an LDC for a connection, the LDC's primary concerns are:
  - Safety (public and employees);
  - Protection against damage to the system;
  - Prevention of interference of supply to others; and
  - Recovery of direct incremental cost (protective equipment, metering, line upgrades)

Proposed right to connect

- Standard Offer Contract OESA proposal seeks the right to connect to the grid
- Renewables are often not near the customer loads
  - Some of the best sites for wind require significant investments and changes to networks
- Renewable generation not located carefully can worsen transmission constraints
- Rural LDCs systems have generally been built to meet agricultural and other low-volume uses and will be insufficient in many cases to connect small-scale DG

Who pays connection costs?

- To simplify standard offer contract, consideration being given to standardize connection costs, thus ignoring differences in costs
- Passing costs onto the wires companies can result in uneconomic location and higher societal cost

EDA Policy

- With respect to DG, distributors should be kept whole and compensated for all costs they incur
- In response to proposal for right to connect for Standard Offer Contracts:
  - Developers of DG and those seeking Standard Contracts should coordinate their siting decision with LDCs and transmitters to help minimize additional wires expenditures

EDA Proposal to Faciliate DG

- LDCs have little to gain from DG with in some cases potential negative impact on distribution system
- There should be a more consistent approach with CDM

Comments on Supply Mix

- EDA takes no position on relative amounts of gas, renewable, coal or nuclear
- EDA main concern is impact on overall price, economy and public acceptance

Energy Council of Canada
Conseil canadien de ’énergie

Energy Council of Canada

Presentation to the

Ontario Power Authority

Energy Supply Mix

Development of an Integrated Power System Plan for Ontario

September 22, 2005

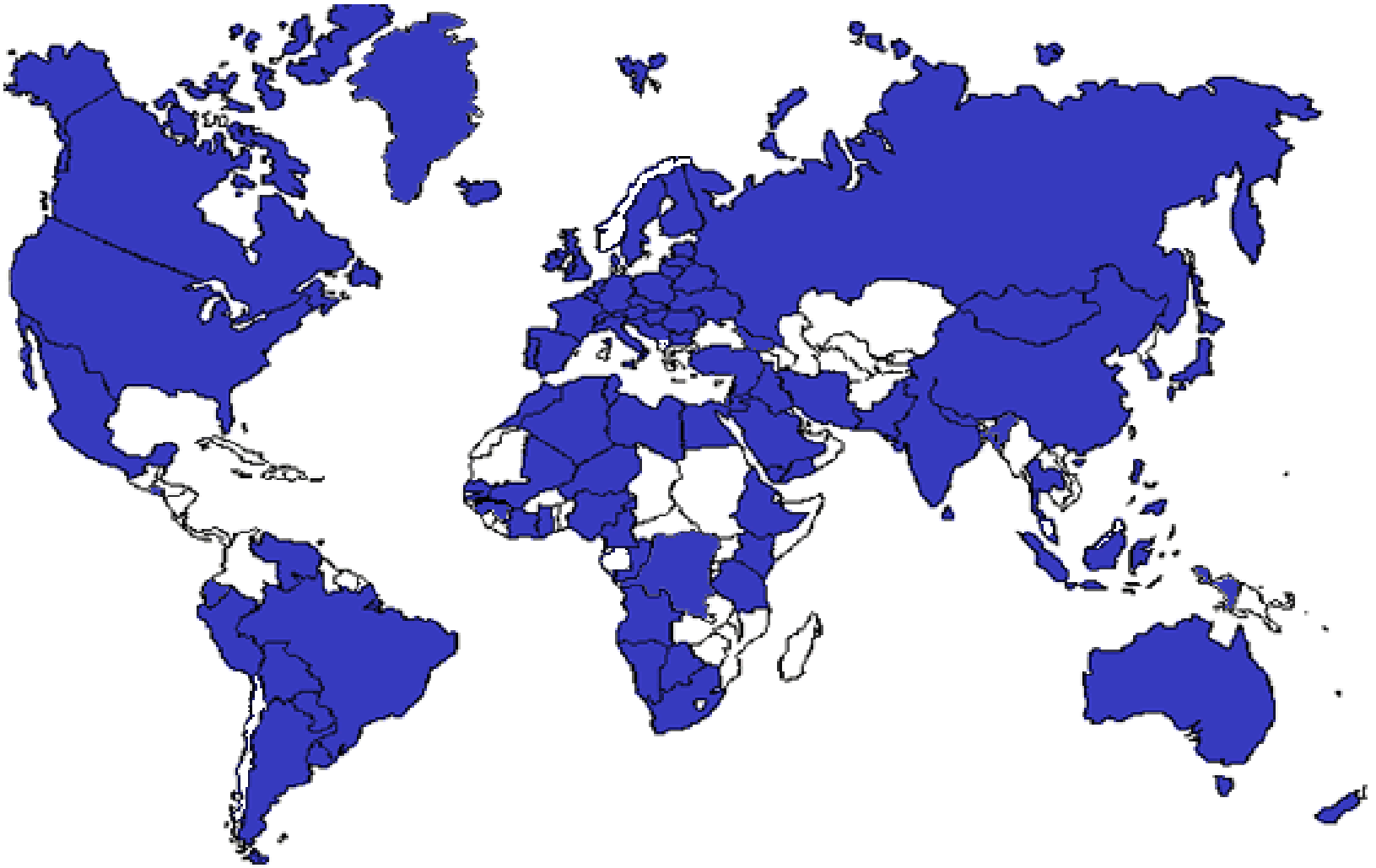
Murray J. Stewart
President

Submission on the Electricity Supply Mix

- **Submission Report of July 28, 2005**
- **Two Summary Attachments:**
  - ***"Delivering Sustainability: Challenges and Opportunities for the Energy Industry"***
  - ***"World Energy Council 2004 Studies"***
- **Ten World Energy Council Studies**
  - ***Energy Market Reform: Lessons Learned and Next Steps***
  - ***Drivers of the Energy Scene Study***
  - ***Energy Efficiency Policies: A Worldwide View***
  - ***Energy End-Use Technologies for the 21st Century***
  - ***Survey of Energy Resources***
  - ***Performance of Generating Plant: New Realities, New Needs***
  - ***Handbook of Renewable Energy Projects***
  - ***Towards Local Energy Systems: Revitalizing District Heating and Cogeneration in Central and Eastern Europe***
  - ***Sustainable Global Energy Development: The Case for Coal***
  - ***Comparison of Energy Systems using Life Cycle Assessment***

World Energy Council
Conseil mondial de l'énergie

WEC is in 98 Countries



World Energy Council
Conseil mondial de l'énergie

What is WEC?

- The leading global pan-energy organization
- Founded in 1923
- Represents all energy sectors
  - including coal, oil, natural gas, nuclear, hydro, renewables
- Comprised of 90+ autonomous Member Country Committees
  - Representing energy producers and providers, energy marketers, energy users, energy ministers, government agencies, decision makers, policy makers, researchers, academic institutions, and environmental organizations
- An official UN accredited NGO
- London UK Headquarters
- A strategic partner with other leading global energy related organizations

Dedicated to promoting the sustainable supply and use of energy for the greatest benefit of all

Energy Council of Canada
Conseil canadien de l'énergie

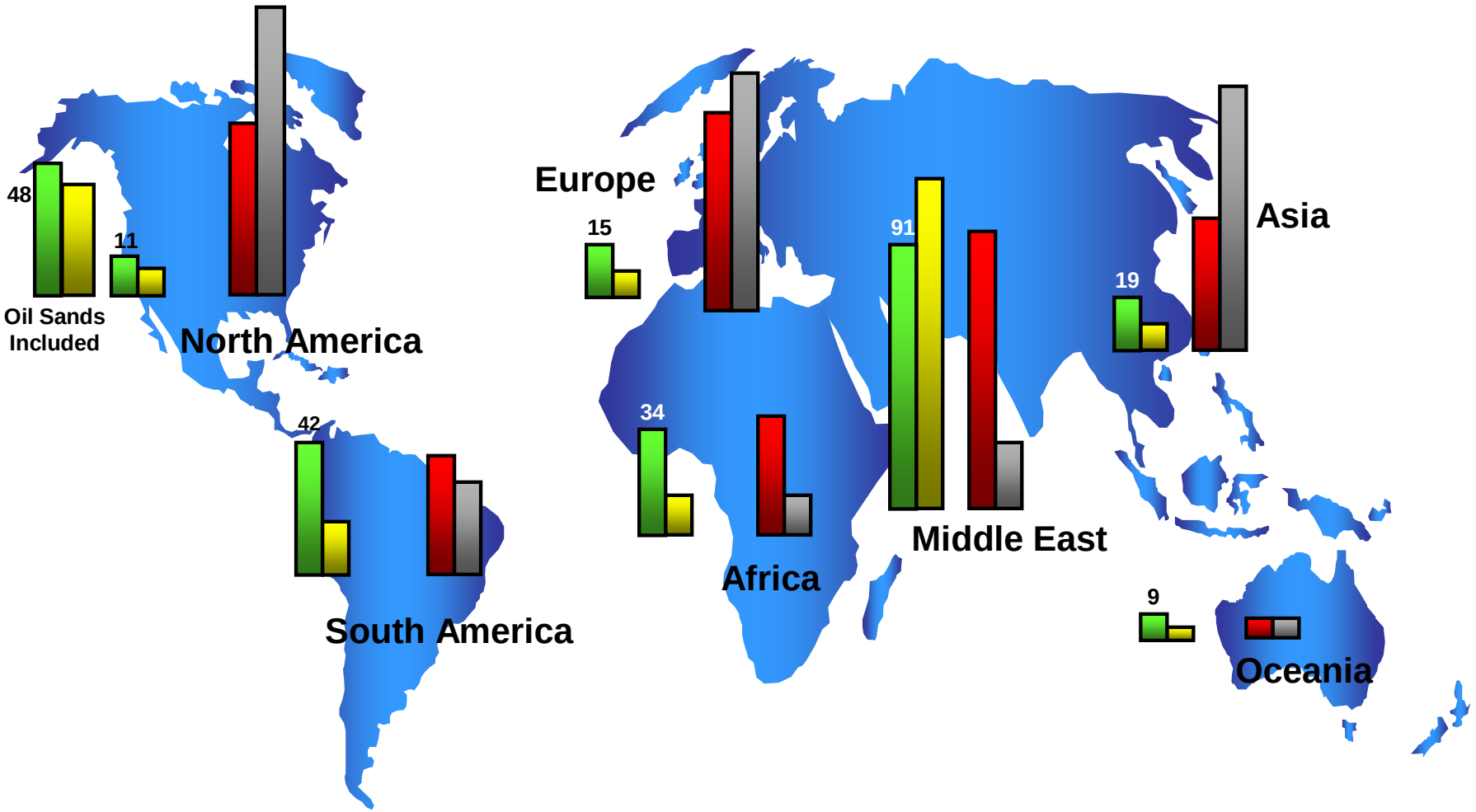
Delivering Energy Sustainability

- All energy options must be kept open and no technology should be idolised or demonised.
- A larger share of global infrastructure investment must be devoted to energy.
- A more pragmatic approach to market reform is emerging.
- The reliability of electricity supply is an important priority.
- Regional integration of energy supply systems can boost access and energy supply security.
- Climate change is a serious global concern.
- Technological innovation and development is vital to reconciling expanded energy services for more equitable economic development with protection of the environment.
- Research and development must be more strongly and consistently supported than has been the case.
- Public trust must be won and retained.
- Public understanding and trust starts with the youth.

World Energy Council
CONSEIL MONDIAL DE L'ENERGIE

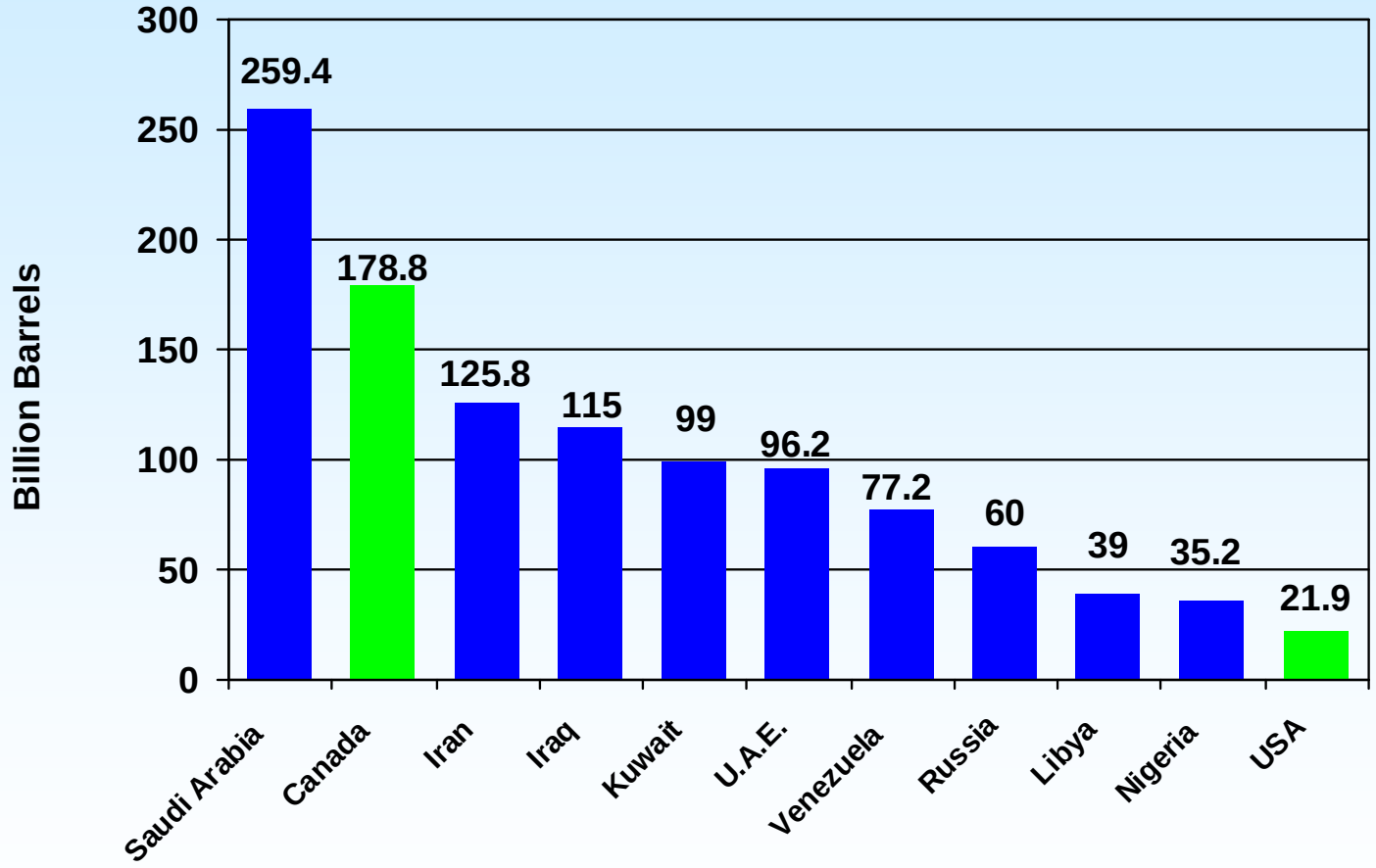
Survey of Energy Resources 2004

Oil



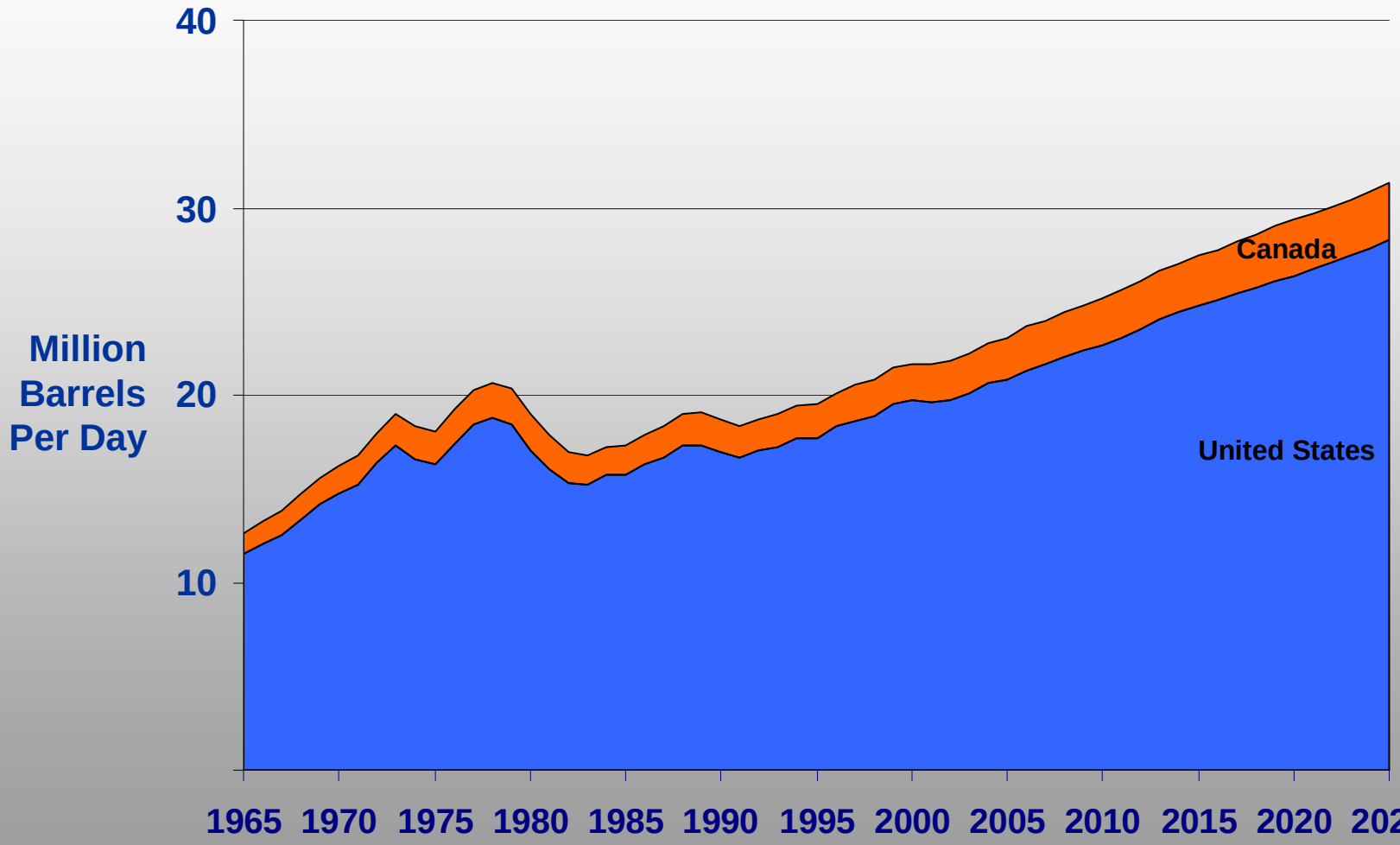
R/P RATIO	RESERVES	PRODUCTION	CONSUMPTION
41.2 years	148 Gt	3.5 Gt/year	3.5 Gt/year

World's Top Proved Oil Reserves



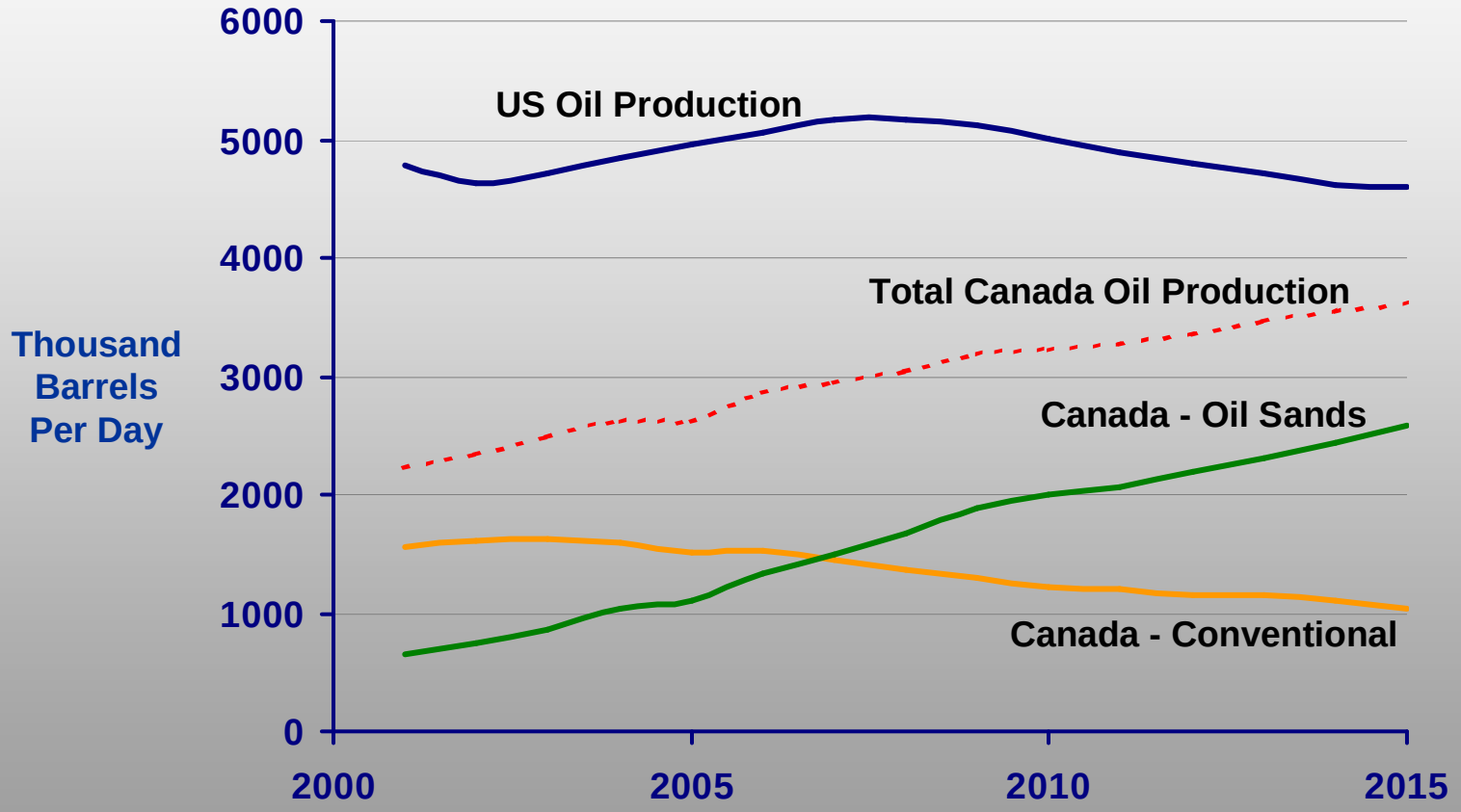
Source: Oil and Gas Journal, December 20, 2004. Figures are as of January 1, 2005.

North American Oil Demand

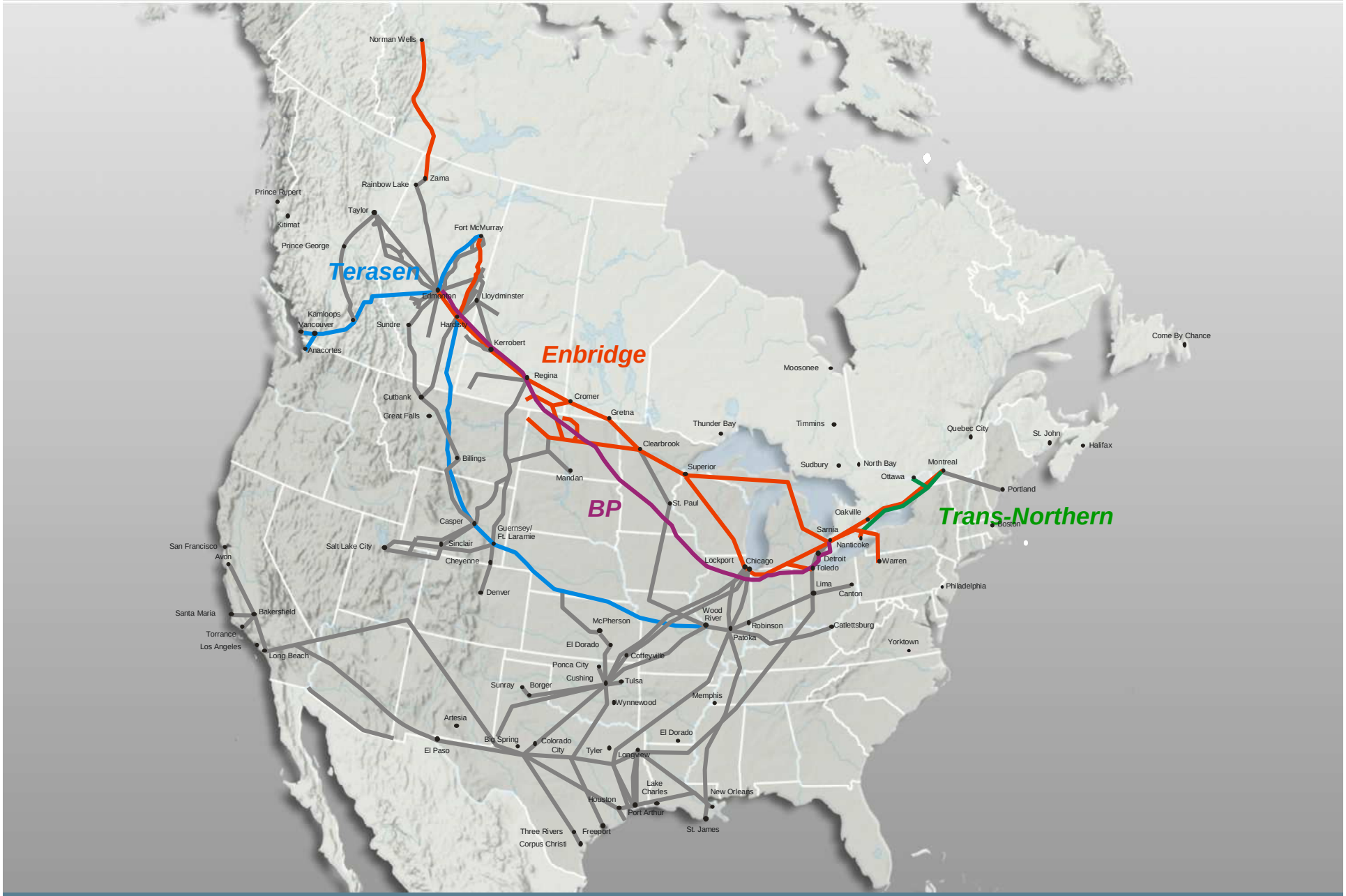


Source: NEB, EIA, BP Statistical Review

Canada and US Oil Production



Source: EIA, CAPP



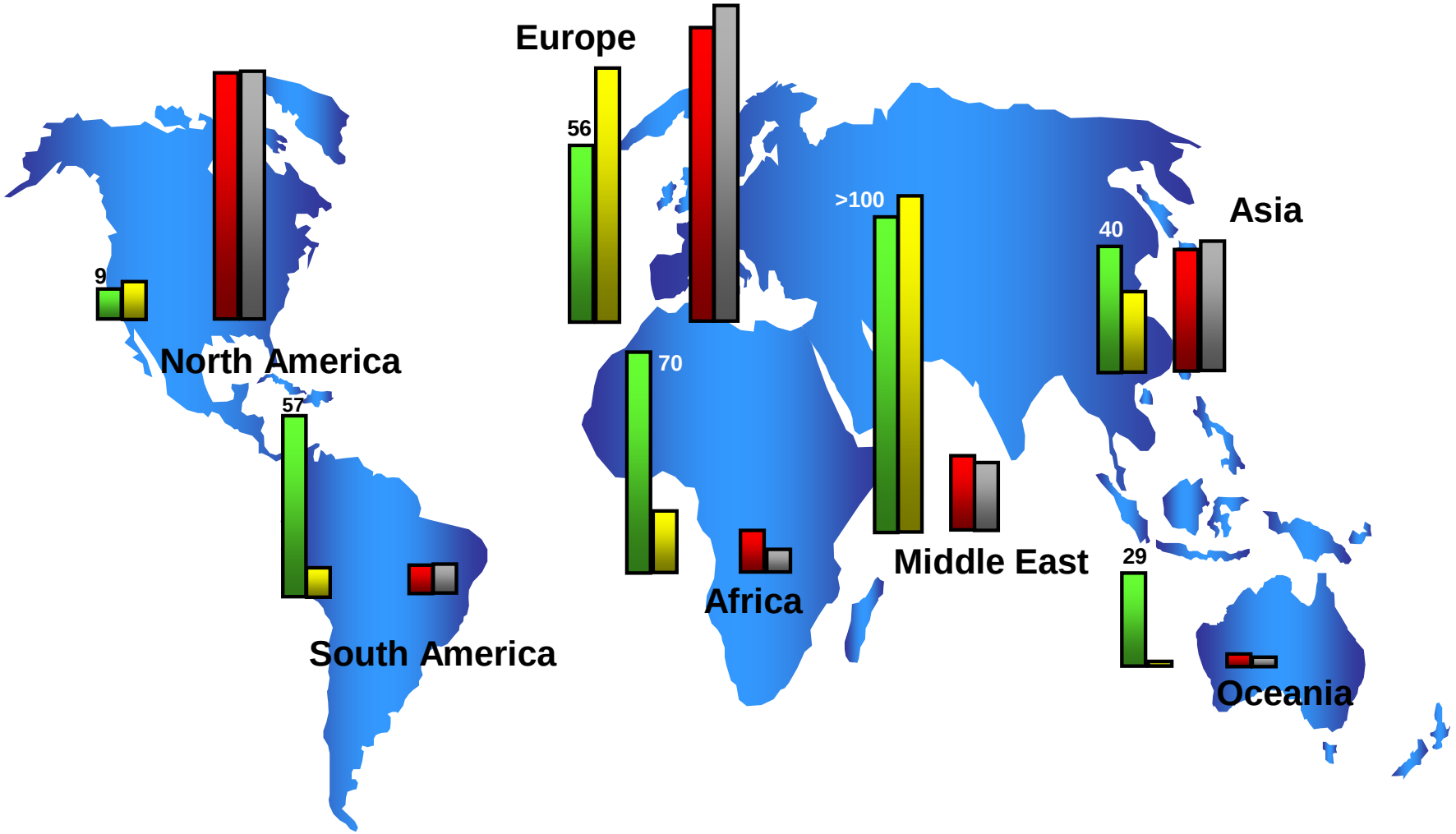
CEPA Canadian Energy Pipeline Association
Association canadienne de pipelines d'énergie

Member Company
Liquid Petroleum Pipelines

World Energy Council
CONSEIL MONDIAL DE L'ENERGIE

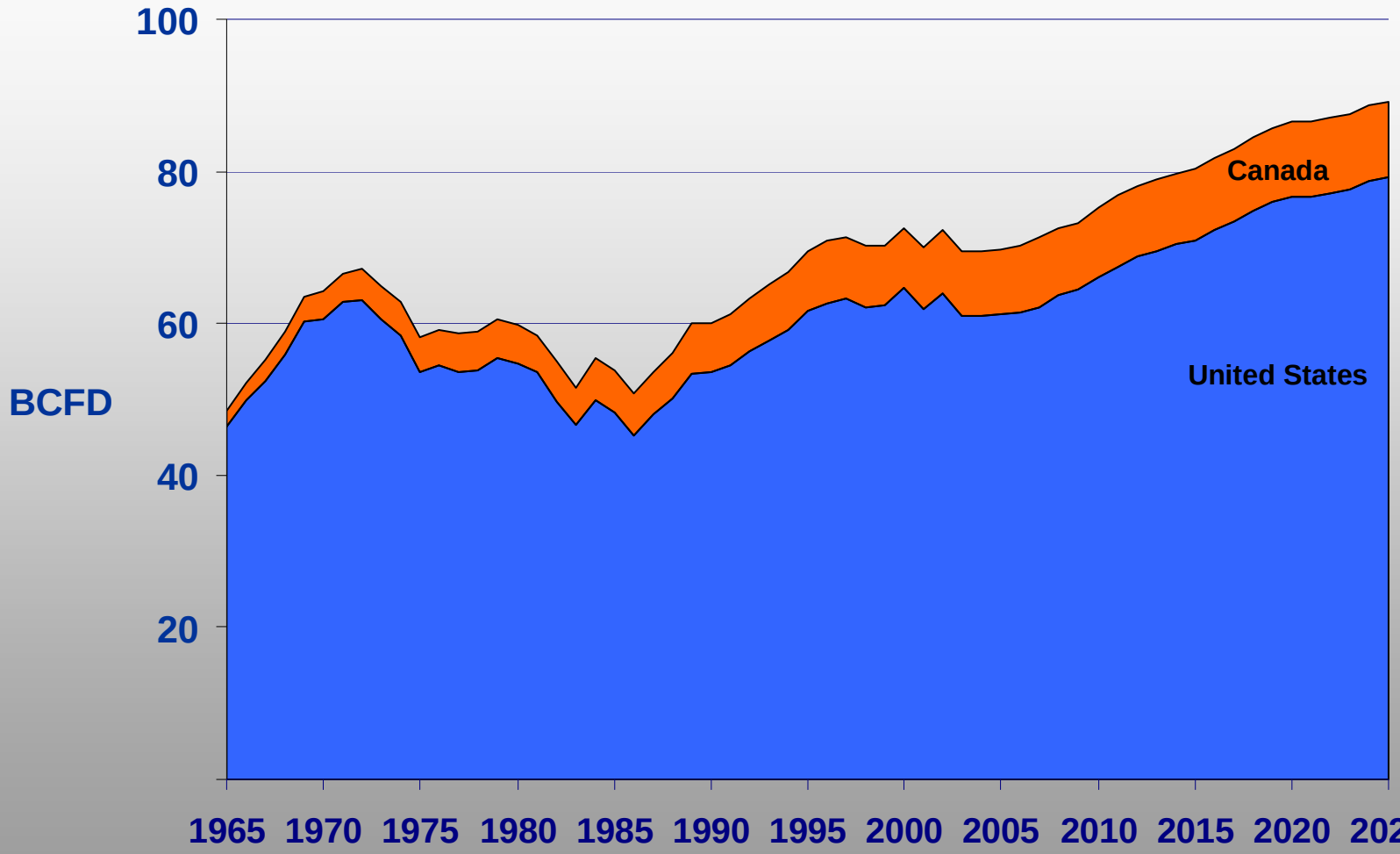
Survey of Energy Resources 2004

Natural Gas



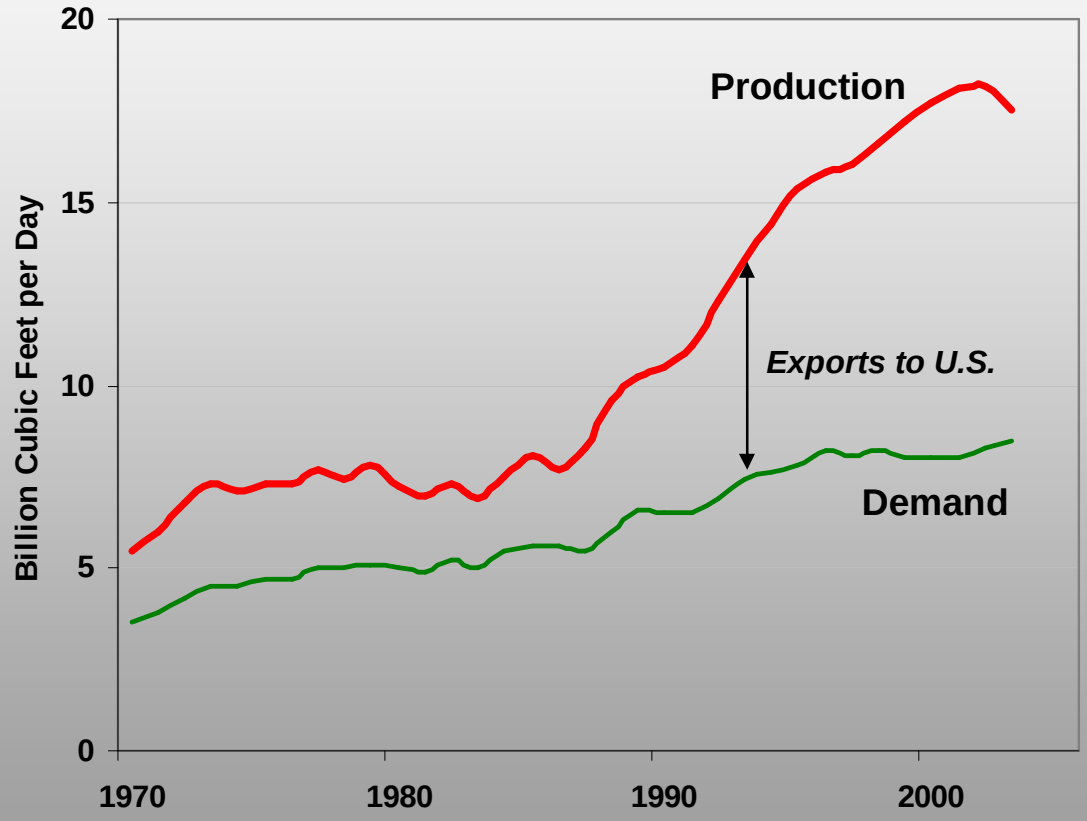
R/P RATIO	RESERVES	PRODUCTION	CONSUMPTION
59.8 years	171 tcm	2.6 tcm/year	2.6 tcm/year

North American Natural Gas Demand



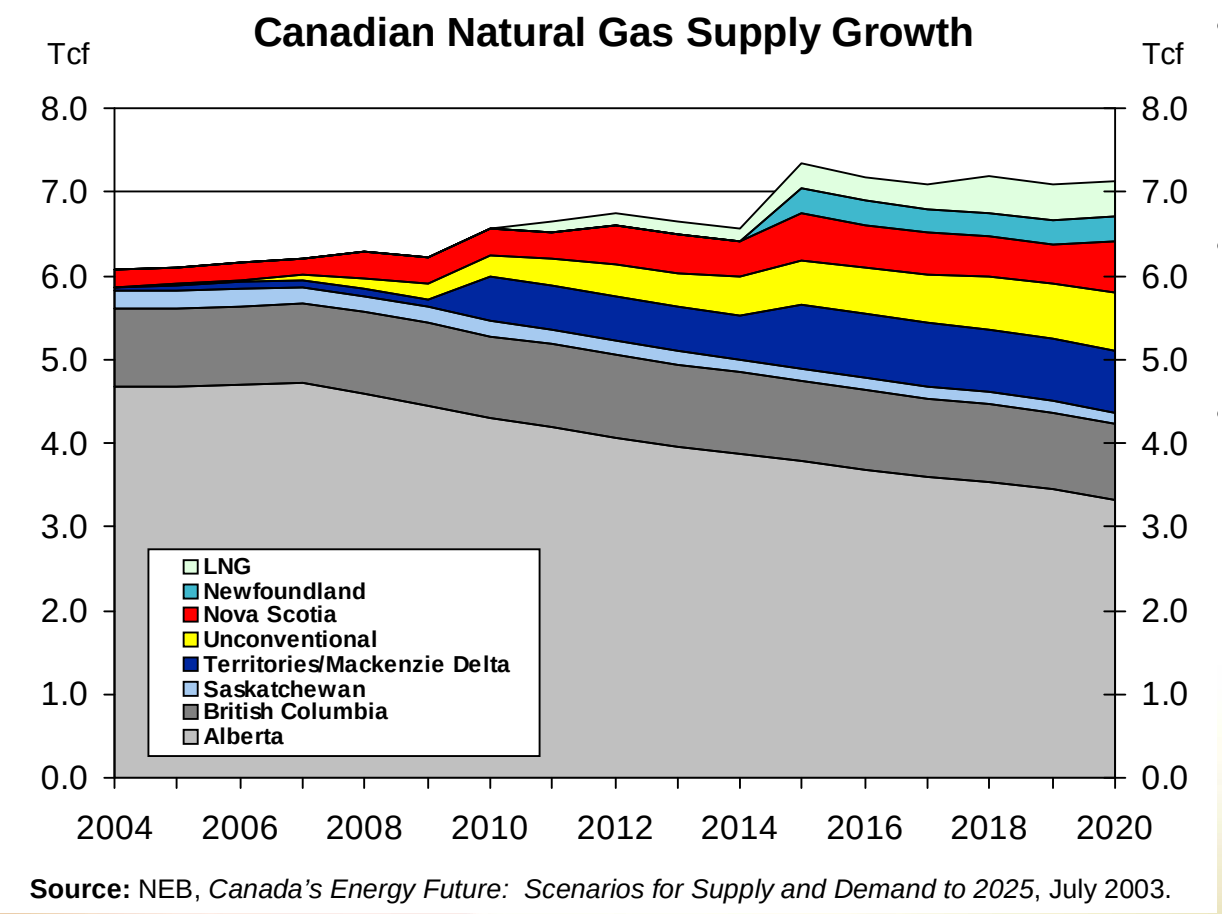
Source: NEB, EIA, BP Statistical Review

Canadian Natural Gas Supply & Demand



Source: NEB, BP Statistical Review

Canada's Future Natural Gas Supplies



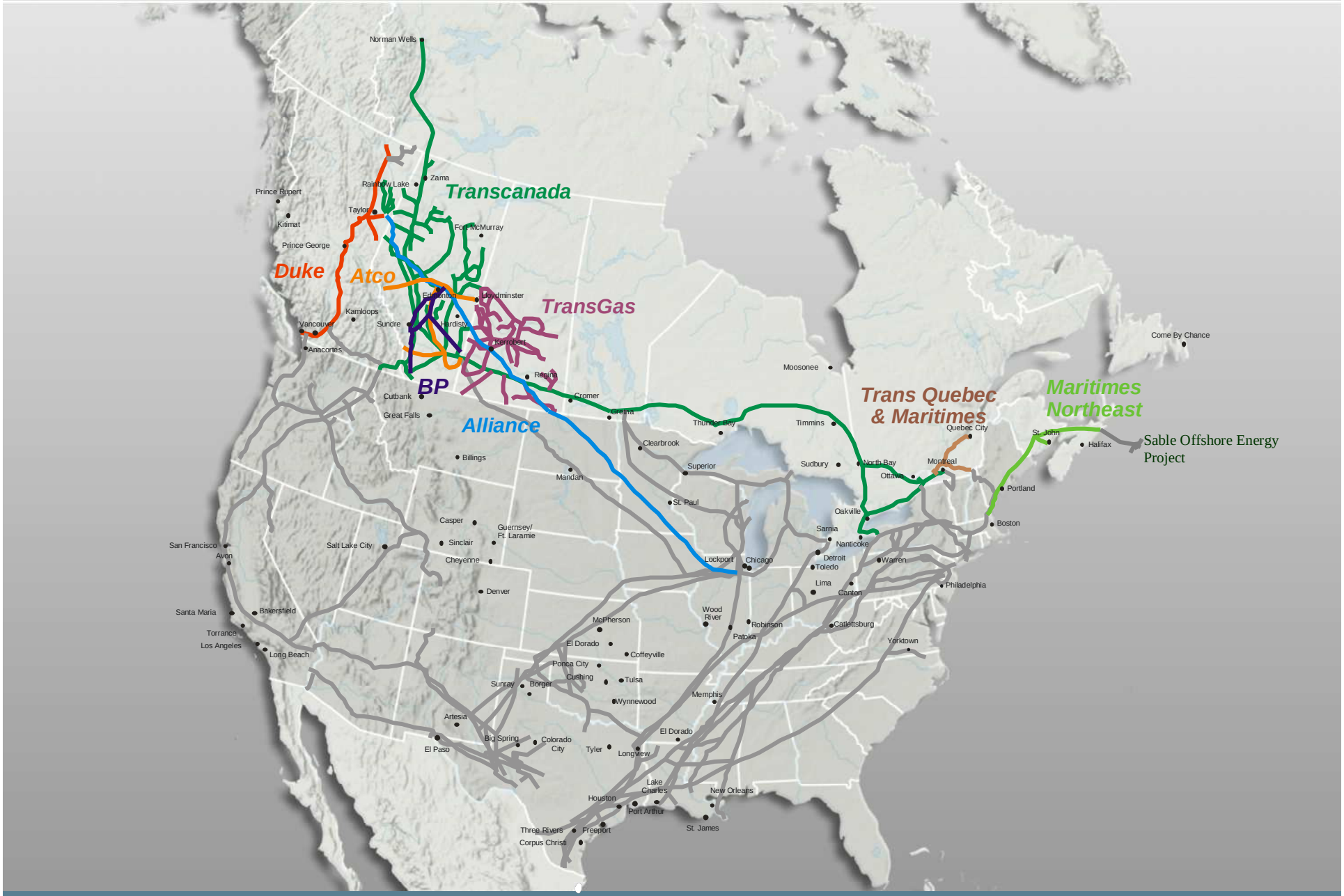
Source: NEB, *Canada's Energy Future: Scenarios for Supply and Demand to 2025*, July 2003.

While conventional natural gas supplies are increasing only moderately, demand continues to grow at a steady pace.

Together, this implies that new sources of natural gas will be required

New supply sources of natural gas emerging:

- coalbed methane
- Mackenzie Delta and Alaska
- east coast offshore
- west coast offshore? (moratorium)
- liquefied natural gas
- compressed natural gas (offshore Newfoundland)
- methane hydrates

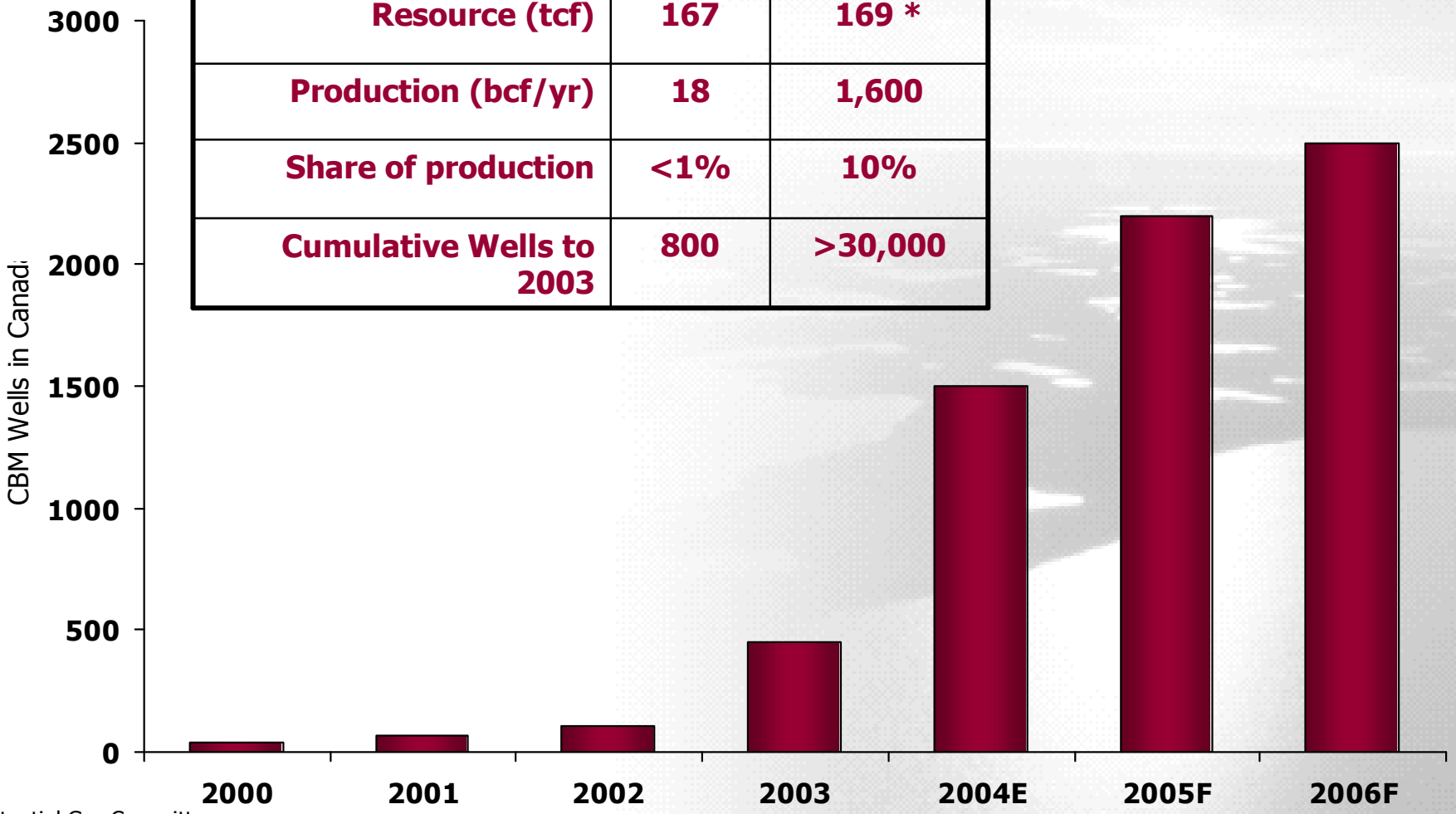


CEPA Canadian Energy Pipeline Association
Association canadienne de pipelines d'énergie

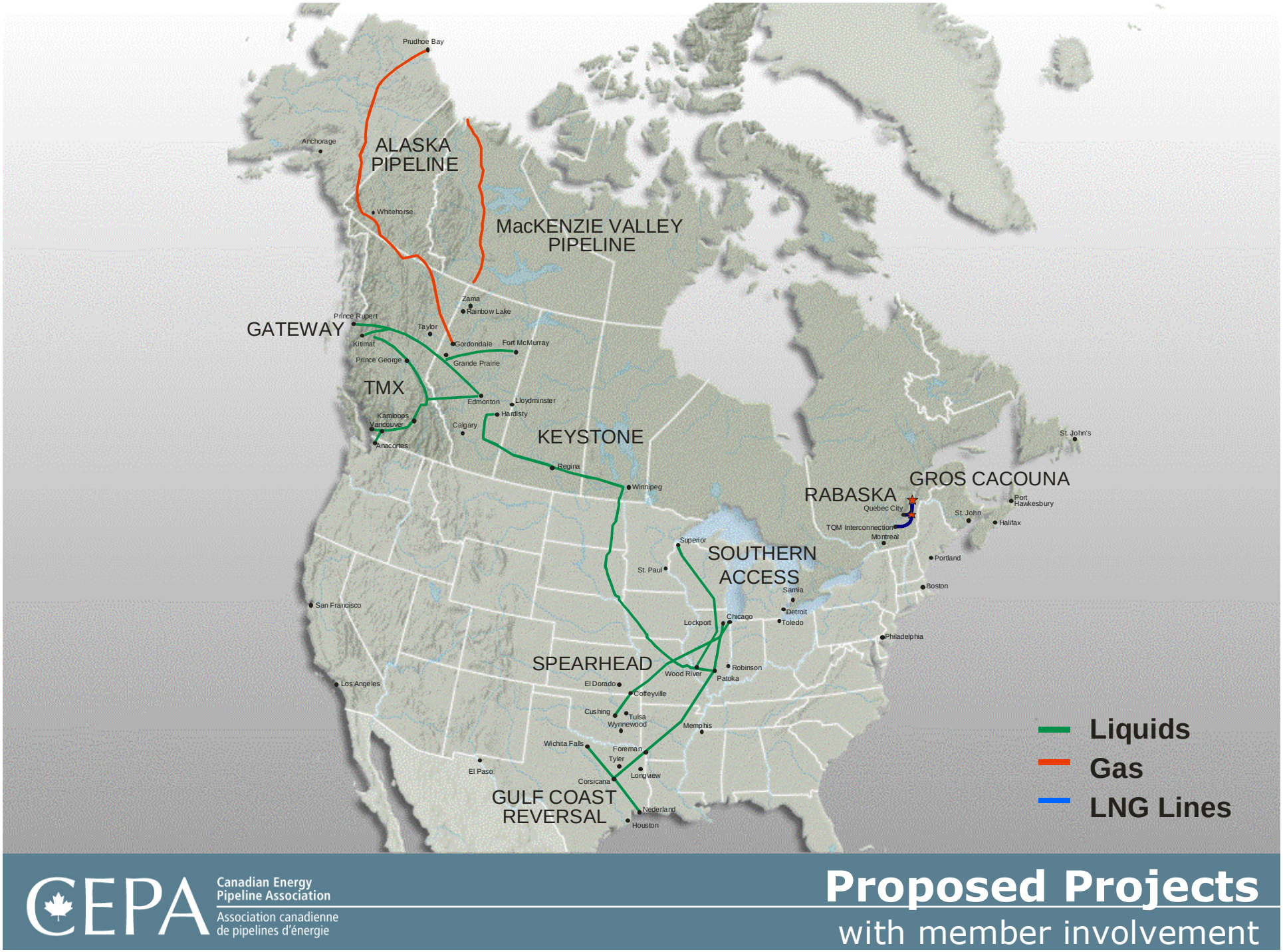
Member Company
Natural Gas Pipelines

Coalbed Methane Wells (NGC) Drilled in Western Canada by year

2003	Canada	U.S.
Resource (tcf)	167	169 *
Production (bcf/yr)	18	1,600
Share of production	<1%	10%
Cumulative Wells to 2003	800	>30,000



* Potential Gas Committee
Source: FirstEnergy & CAPP estimate

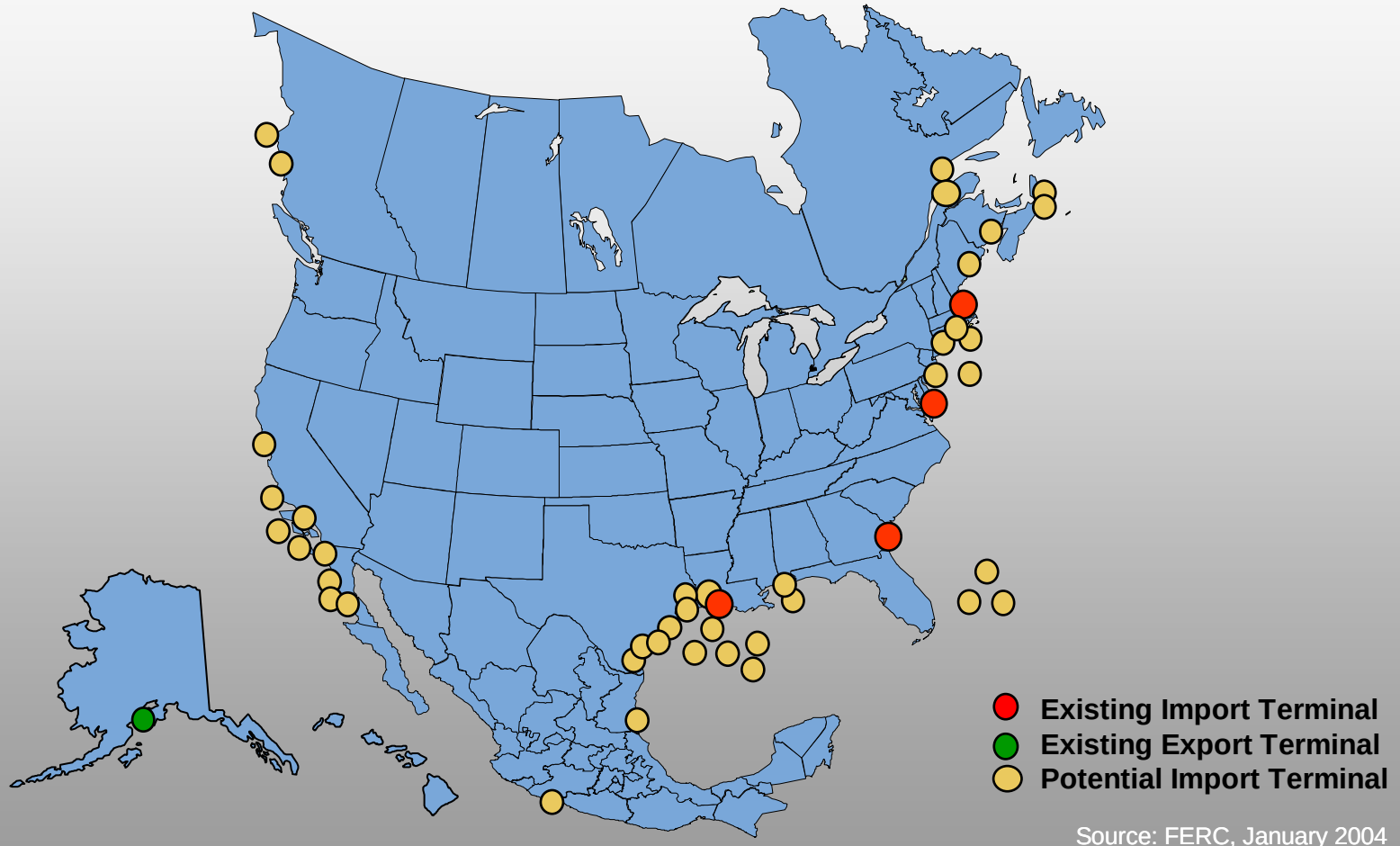


CEPA Canadian Energy Pipeline Association
Association canadienne de pipelines d'énergie

Proposed Projects

with member involvement

North America LNG Development

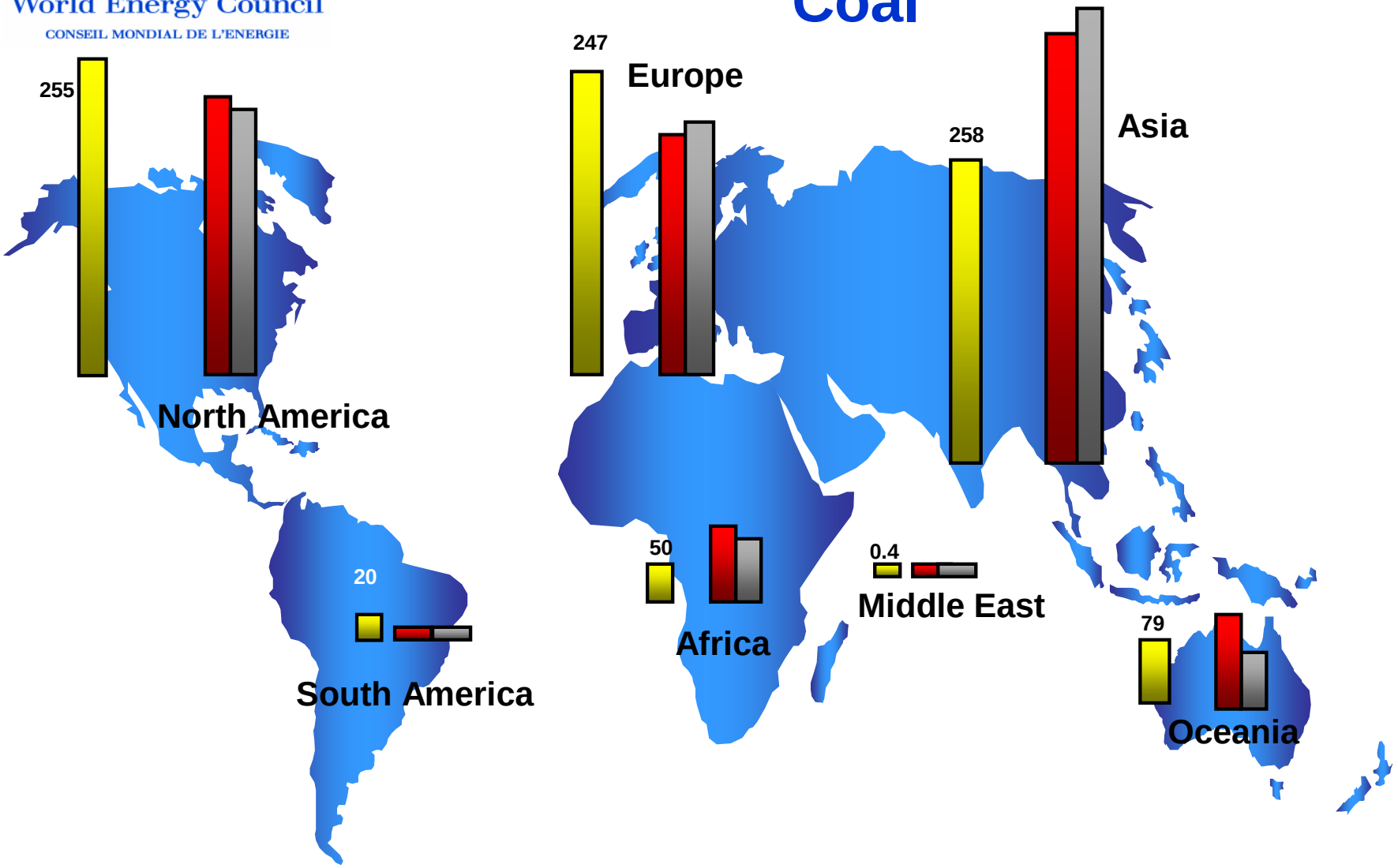


Source: FERC, January 2004

World Energy Council
CONSEIL MONDIAL DE L'ENERGIE

Survey of Energy Resources 2004

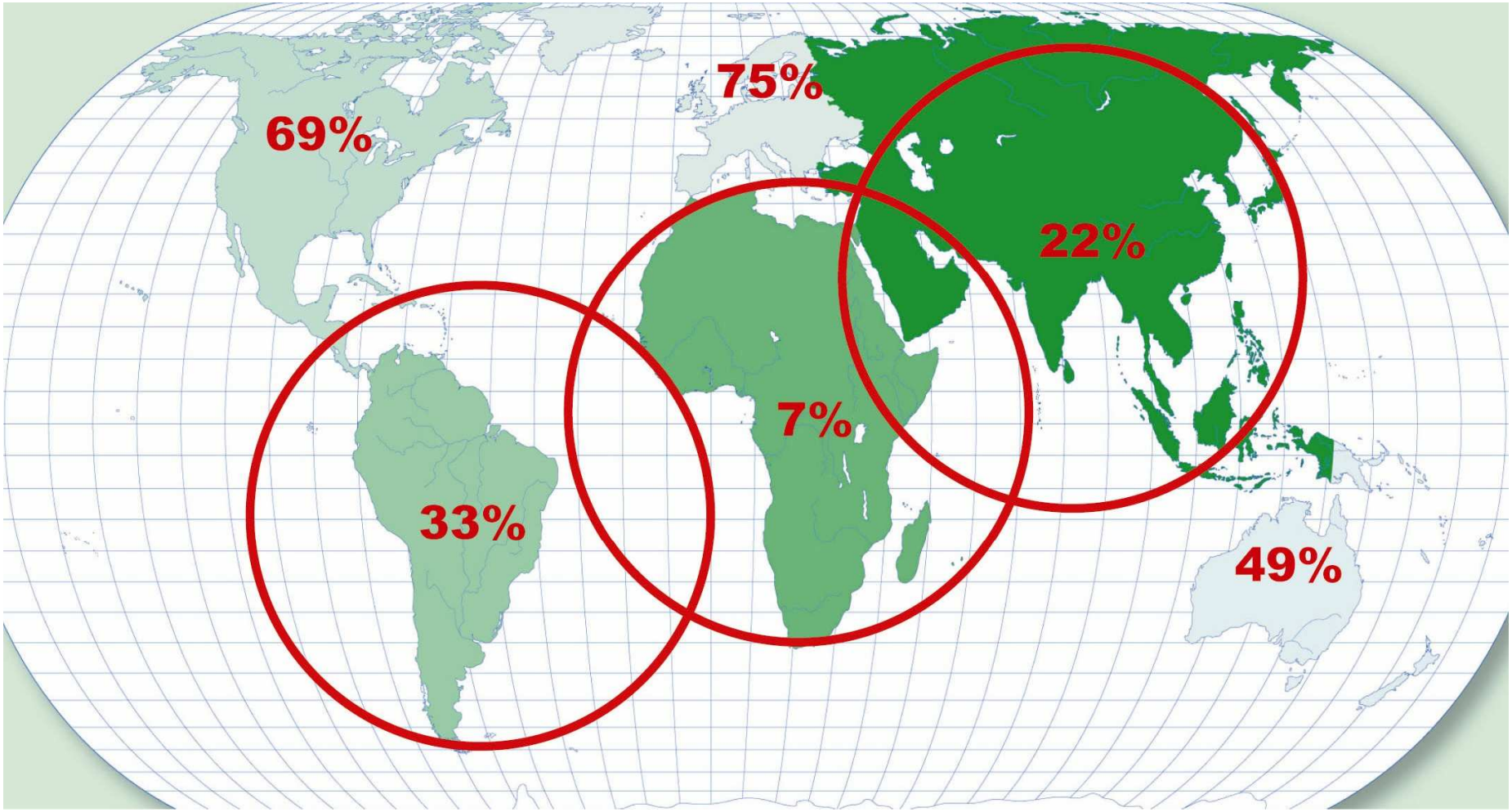
Coal



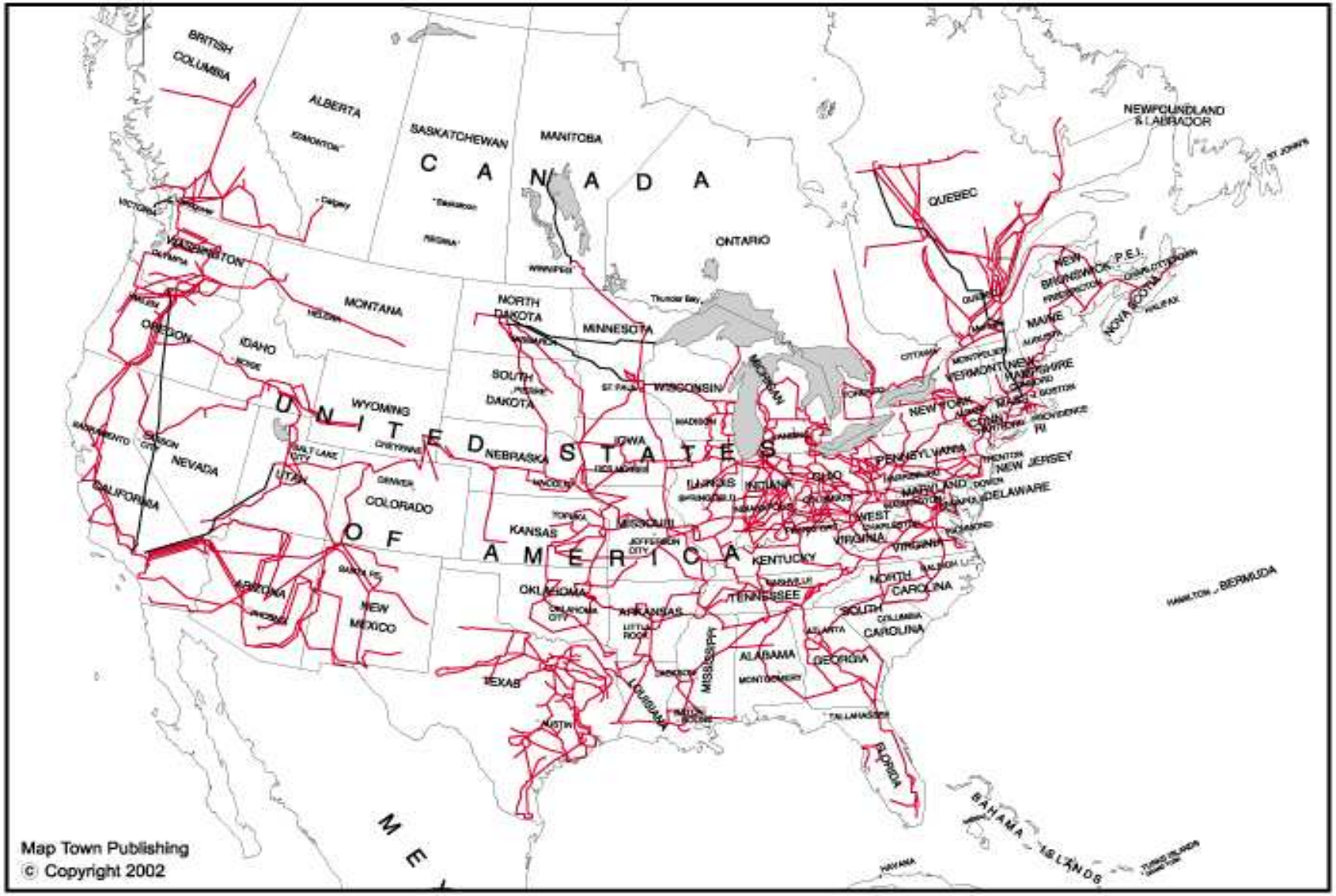
RESERVES	PRODUCTION	CONSUMPTION
909 Gt	4.8 Gt/year	4.8 Gt/year

World Energy Council
CONSEIL MONDIAL DE L'ENERGIE

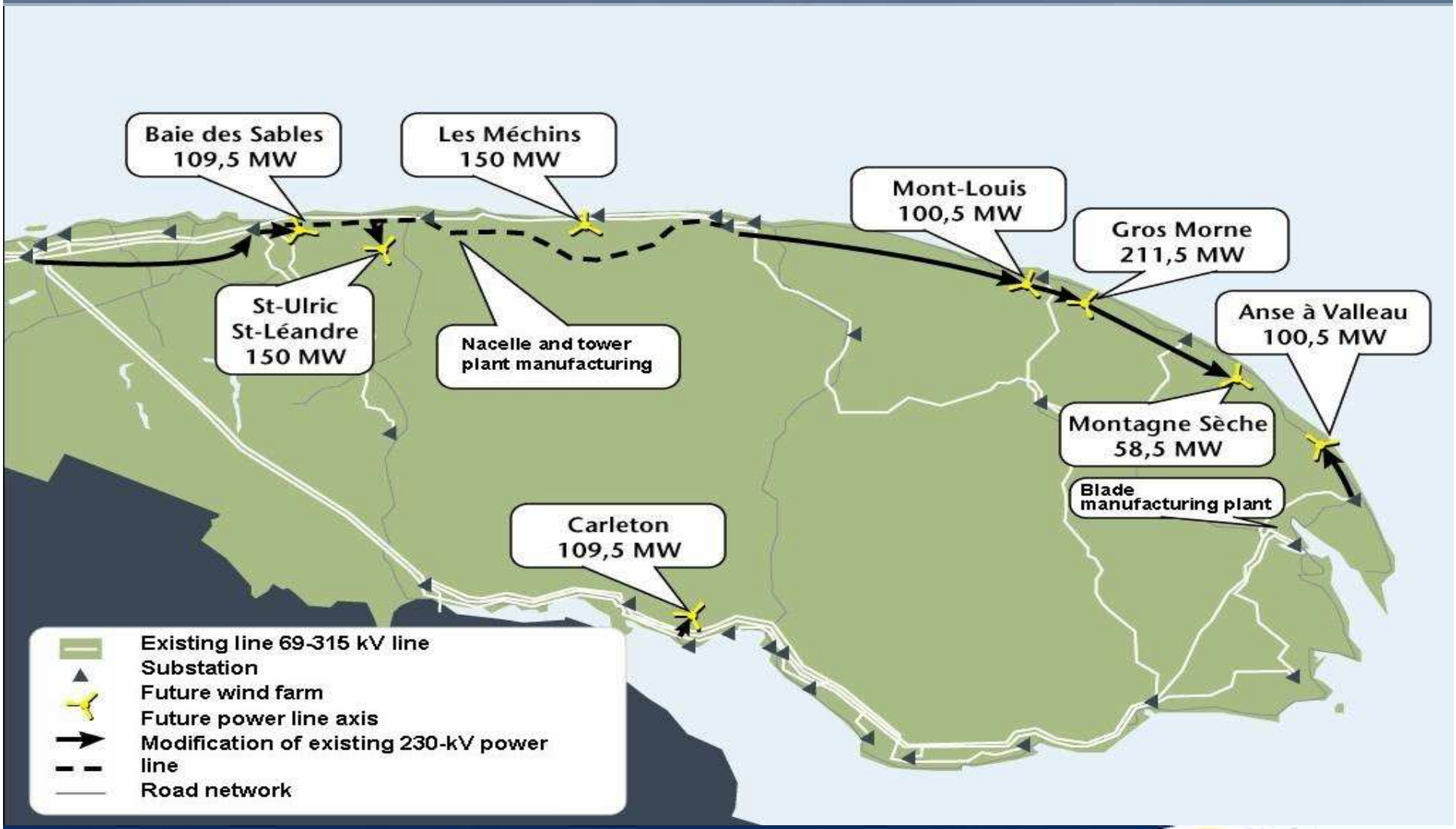
Hydropower: Usage/Potential (2002)



Canada – USA Electricity Interconnections



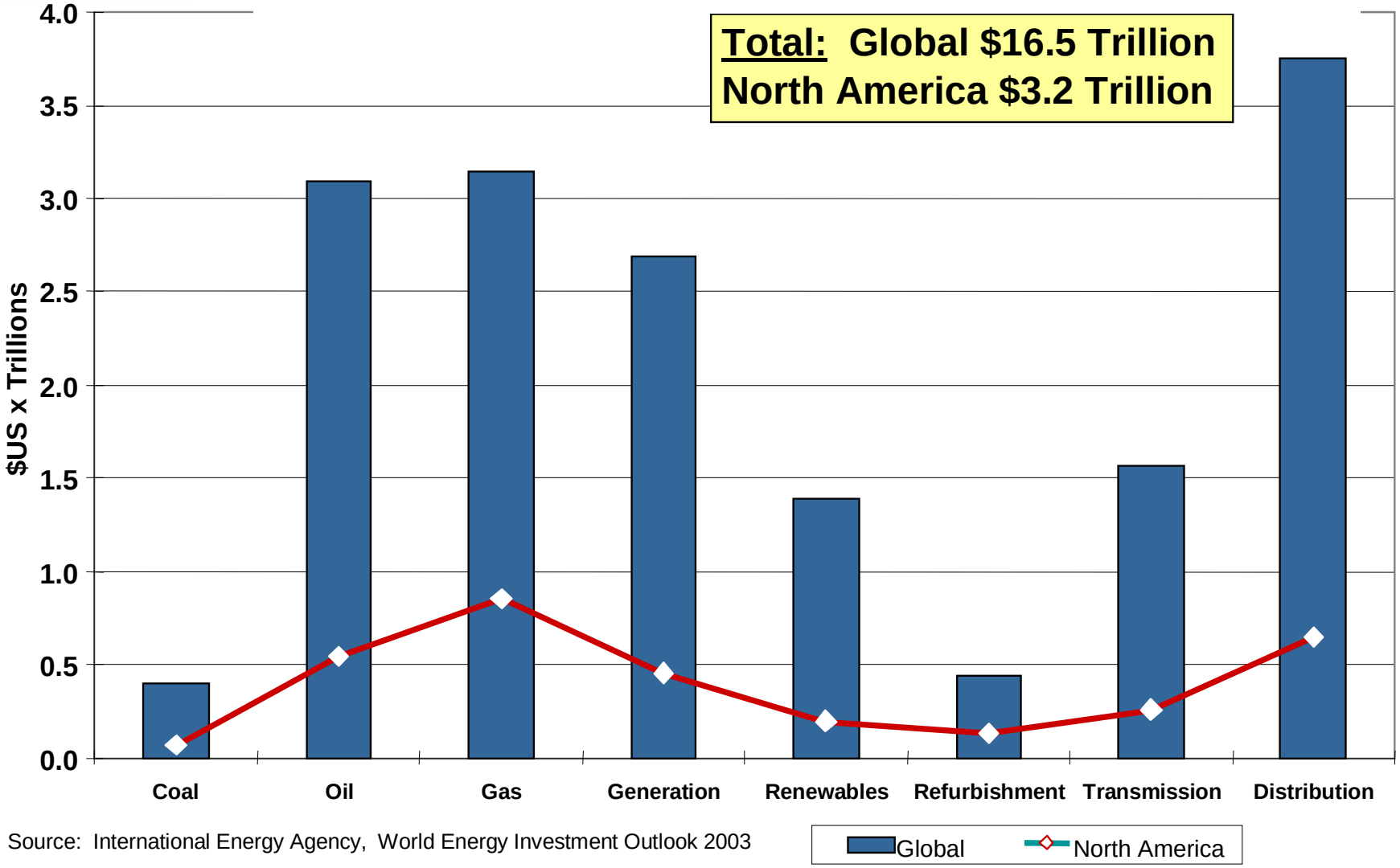
Wind energy call for tenders – 2003



Winning bids

- Projects built each year: 2006 to 2012
- 990 MW @ 36.6% C.F. = 3.2 TWh
- 45% more energy than anticipated (3.2 TWh vs 2.2 TWh)
- Average price: 6.5 ¢/kWh + 1.3 ¢/kWh in transmission costs = 7.8 ¢/kWh (2007 $ and increasing thereafter at the forecast rate of inflation of 2%)
- Cost of balancing service to counter the intermittence of wind energy generation, i.e. about 0.9 ¢/kWh
- Transmission and balancing costs will be included in Hydro Québec Distribution's rates

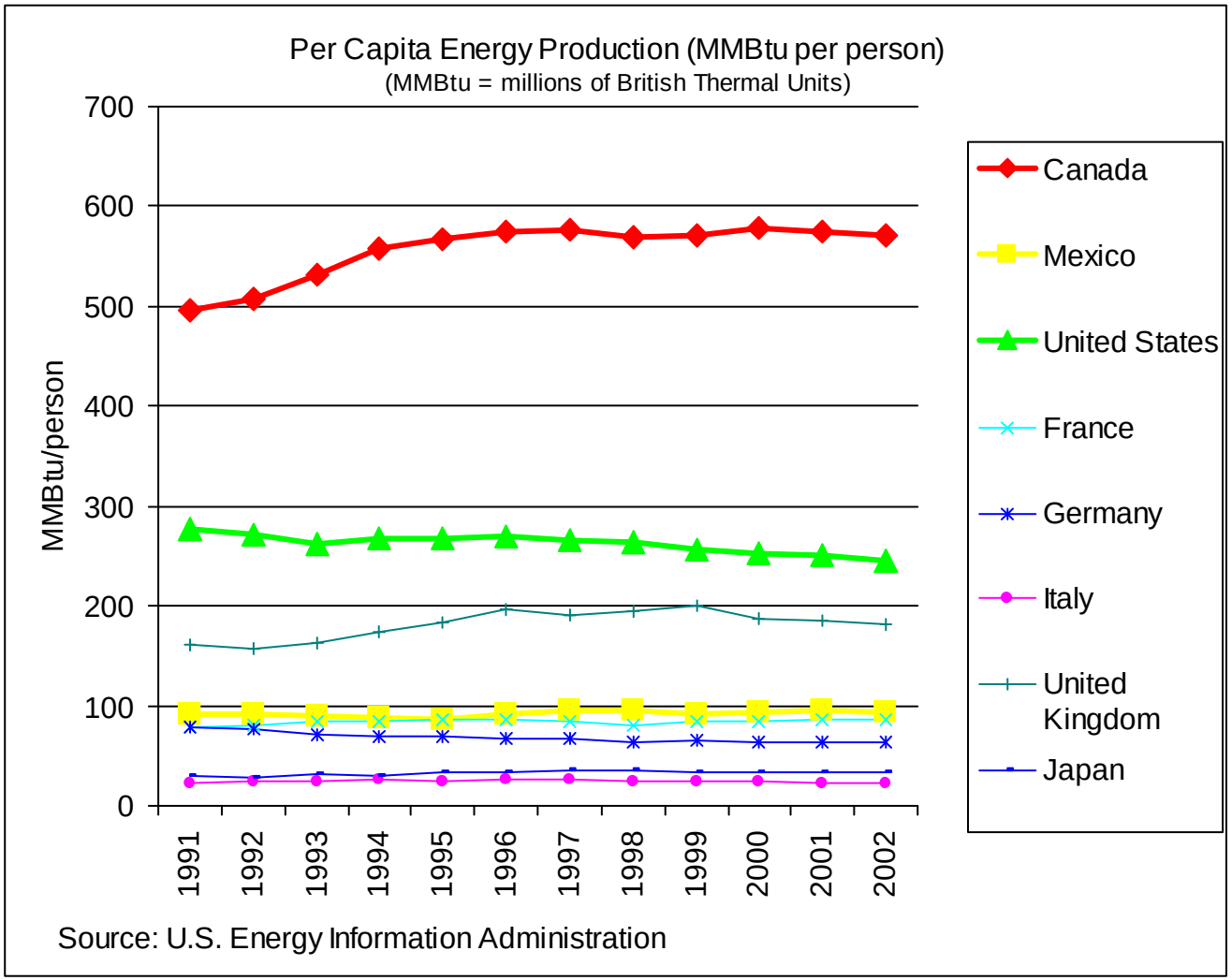
Huge Capital Investment is Planned for 2001 – 2030



Source: International Energy Agency, World Energy Investment Outlook 2003

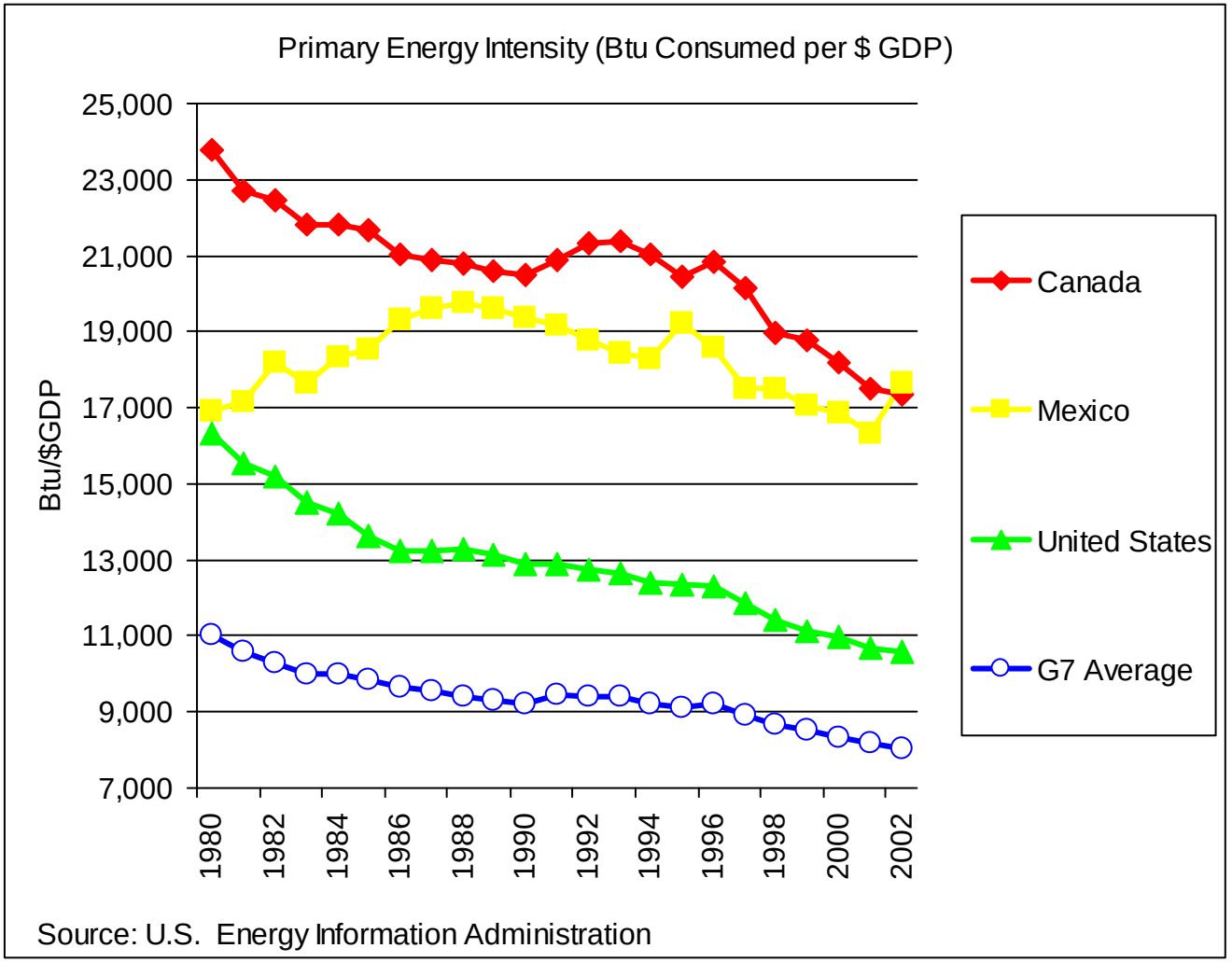
Comparative Canadian Energy Production

- **Energy represented 5.8% of total Canadian GDP in 2003.**
- **Energy GDP totaled just under $60 billion ($1997).**
- **Energy GDP has grown by 2.2% per year since 1981 vs. overall GDP growth of 2.7%.**

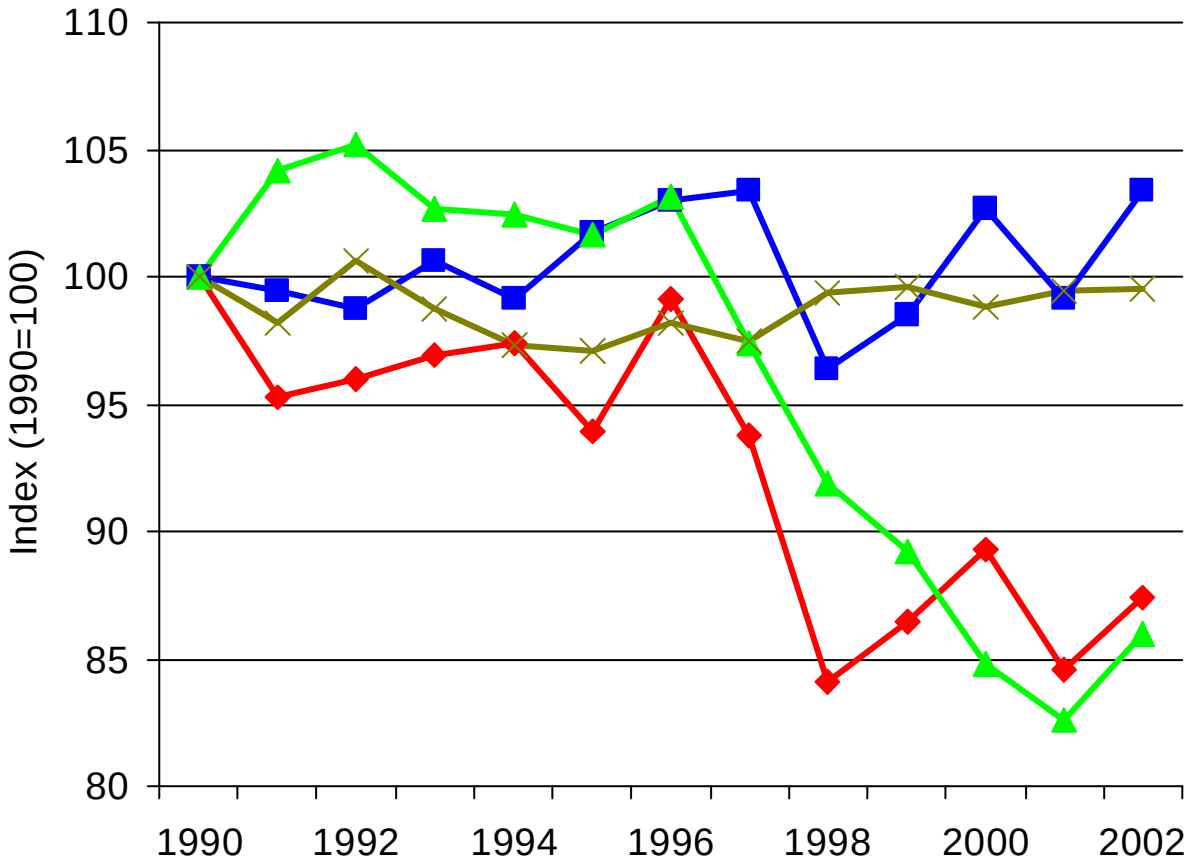


Canadian Energy Intensity

- **Canada is the most energy intensive economy in the G7 and NAFTA.**
- **But efficiency gains have helped reduce Canadian energy intensity despite strong overall growth in economic activity.**



Canada's Energy intensity: by end-use sector



The Commercial sector saw modest gains in efficiency

Transportation: More efficient vehicles of all sizes, but more minivans and SUVs and more travel per car

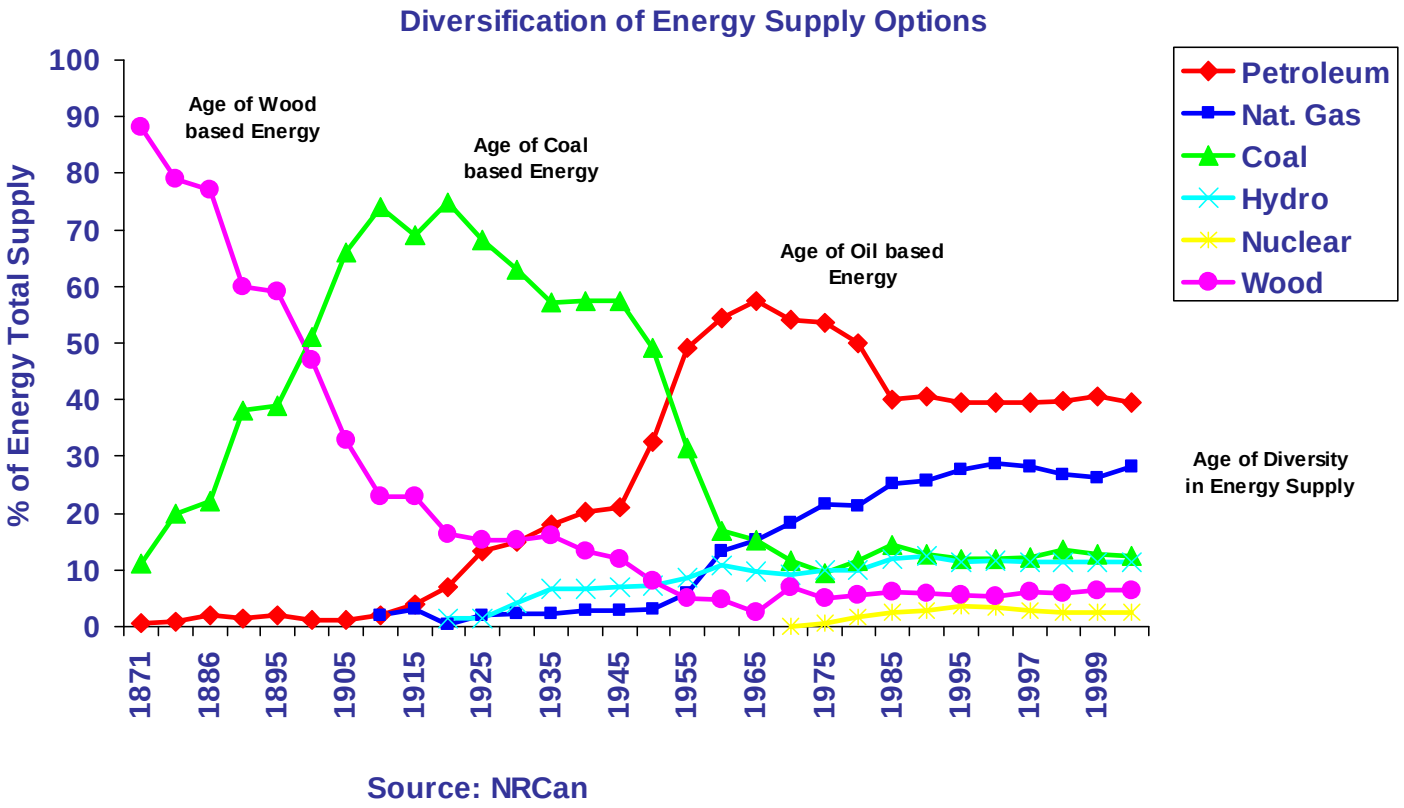
Residential: Better thermal envelopes of houses and higher-efficiency appliances and space and water heating equipment

Industrial energy intensity fell due to a shift in industries and efficiency gains

Source: NRCan

Growing diversity of energy supply – Canadian perspective

- Historical trend is toward supply diversity.
- Next generation of fuels & technologies even more diverse
- Natural Gas and technologies that use natural gas will be a key part of that future.



Source: Canadian Gas Association

For more information, please contact

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K1R 7S8

murray.stewart@energy.ca

www.energy.ca

Presentation to the Ontario Power Authority

Enabling Clean Infrastructure Opportunities: Stationary Fuel Cells Part of Ontario's Diversified Electricity Portfolio

David Teichroeb
September 22, 2005

FUEL CELLS CANADA

> Accelerating Canada's World-Leading Fuel Cell and Hydrogen Industry

Discussion Outline & Messaging

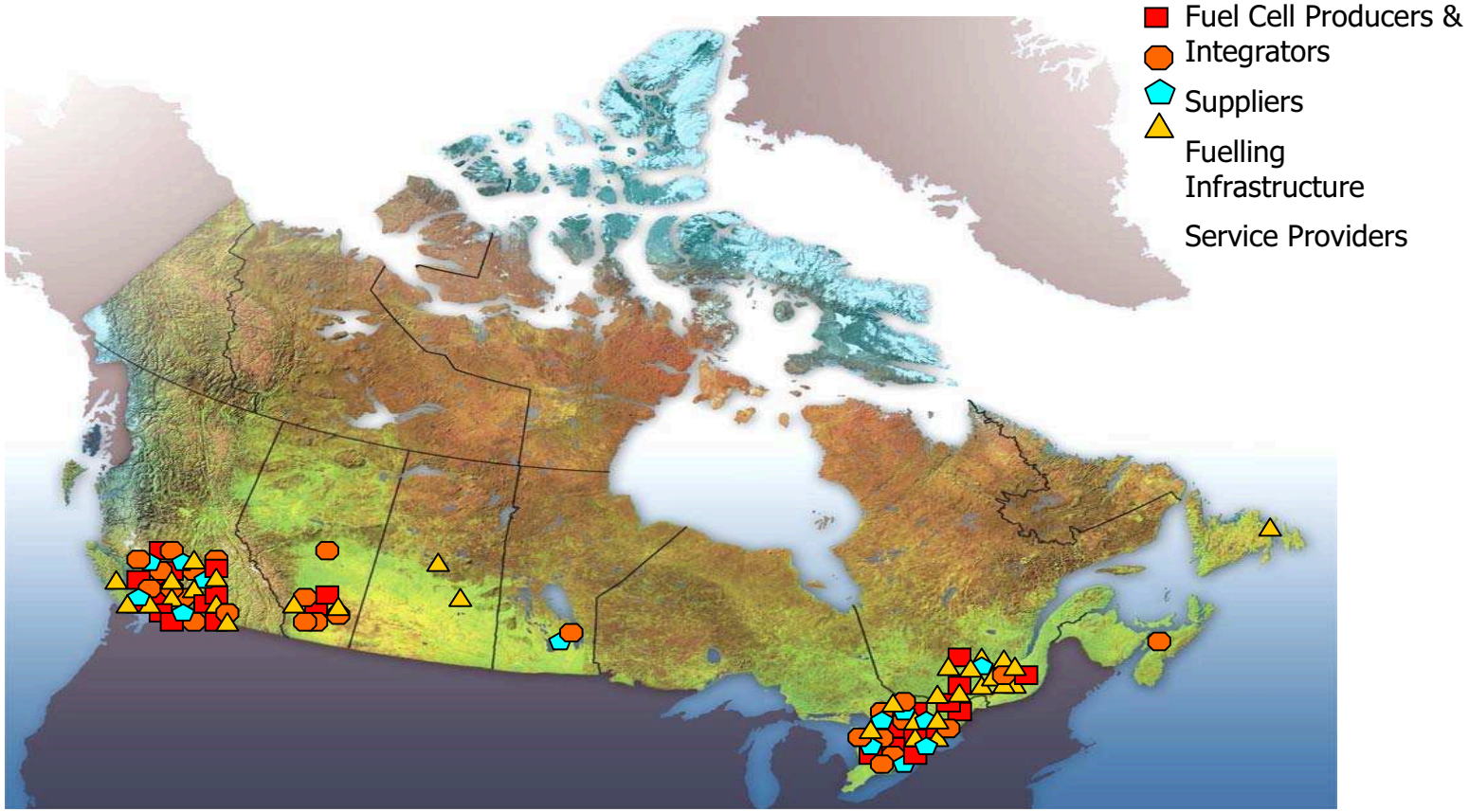
- Readiness of fuel cell technologies
  - Identifying today's commercial applications
- A role in Ontario's diversified electricity portfolio
- Stationary fuel cells: part of the solution
- How this solution can be put to work

FUEL CELLS CANADA

Fuel Cells Canada

- National not-for-profit industry association
- Founded in October 2001
- Mission is to promote the development and commercialization of Canadian hydrogen and fuel cell technologies, products and services
- Prime source of services and support to companies, educational institutions and business alliances promoting, developing and demonstrating fuel cell and related products and services in Canada
- 67 member companies and organizations across Canada

Leadership Across the Country



Commercial Opportunities for Fuel Cells Today

Varied fuel cell technologies/applications

- R&D for some technologies, commercialization for others
- Some stationary technically commercial
  - Correct policy support needed

Utilities are a key commercialization path in Ontario

- Small stationary technology
  - High quality power for utility communication systems (today)
  - High efficiency, near-zero emission distributed generation
    - R&D and near-commercial
- Large Stationary technology has scale to offer substantive utility grade solutions
  - Sub-megawatt to multi-megawatt installations today
  - RFPs/Call for Tenders on 10MW systems
  - Market development of 40MW plus fuel cell sites under review

Small Stationary

Ongoing R&D in small commercial technologies

- Focus on near-commercial markets
  - High quality communication & data markets
- Technology evolving for distributed generation
  - e.g. California Self Generation incentive program
  - Potential for High efficiency CHP

FUEL CELL TECHNOLOGIES LTD.

HYDROGENICS CORPORATION

FUEL CELLS CANADA

Grid Support & Multi-Megawatt

One & Two MW Systems

Ratepayer Benefits with
Grid Support & Power Reliability

- Los Angeles Department of Water & Power
- Westerville Ohio
- RWE, Germany
- U.S. Coast Guard
- Deutsche Telecom, etc.

MW System for Santa Rita Correctional Facility

Ontario's Electricity Challenge

- Resolving supply /demand imbalance with diversified infrastructure solutions
- Growth Constraints - transmission and distribution right-of-ways
- Environmental & Social Impacts - emissions; land/water use management, and varied stakeholder expectations
- Cost – renewing aging assets with new supplies and clean operations that maintain Ontario's competitive position to keep and attract industry

FUEL CELLS CANADA

Ontario's Diversified Portfolio Fuel Cells Can Play a Role Today

Diversified Renewable Portfolio

- Fuel cells on renewable gases (waste water treatment plants etc.)
  - High efficiency yields more renewable MWhrs
  - Near zero emissions reduce renewable related smog

    Example: California Self Generation Incentive Program

Diversified Clean Infrastructure Options

- Fuel cells can provide clean air benefits like wind with the additional benefit of capacity to the grid
- A clean urban solution can reduce transmission losses and reduce reliance on grid expansion
  - Potential to invest in solutions that offer combined benefits of increase grid reliability and availability of clean generation

Incorporating Lessons Learned: Fuel Cells Moving Mainstream

Incorporating ideas that fit Ontario's needs:

Long Island Power Authority

- RFP for 10MW of Clean Fuel Cell Electricity

State of Connecticut

- Project 100 (Connecticut Clean Energy Fund)
- Fuel cell electricity eligible in 100 MW renewable RFP

State of New York RPS

- Fuels cells (all feedstock) a renewable technology

California Self Generation Incentive Program

- Tiered support for distributed generation including fuel cells, wind, PV, cogeneration, etc.

Stationary Fuel Cells Part of the Solution

High efficiency, cleaner air, and reduced GHG emissions

↘ Conservation play with additional societal benefits

Market readiness beyond that of automotive technologies

↘ Assistance needed to bring end-users on-side

An immediate ultra-clean solution using today's natural gas infrastructure

↘ Stepping stone to a sustainable hydrogen economy

Low-impact generation compliments renewables

↘ 10% renewable target by 2010

Implementing Solutions

A supportive pubic policy framework

- Recognize the nature, role, and contribution of fuel cells
- Review proven supportive regulatory models in other jurisdictions
- Provide an incentive for utilities to consider alternative investment options that support both infrastructure renewal & clean generation
- Work with industry and federal government to shape buy-in for a portfolio of low-impact generation
  - Low-impact inclusive of renewables and low emission/high efficiency fossil solutions

Targeting Early Adopters

Large Stationary fuel cells a natural fit for utilities

- Optimize urban natural gas + electricity distribution infrastructure
- Cleanest distributed generation capacity
- Delivers power where needed most
  - Utilities understand where DG benefits provide greatest value
  - Enhance Grid reliability with associated environmental benefits
- Opportunity to diversify with alternative infrastructure investments (utilities part of the solution)

FUEL CELLS CANADA

Conclusion: Bridging Ontario's Electricity Gap

- Fuel Cells provide a clean urban source of distribute power
  - Contribute to a sustainable environment + competitive economy
- Well designed public policy can enable fuel cell solutions to proceed sooner
  - Expanded eligibility for federal power production incentives
  - Provincial RFP's, or other similar public policy efforts, can embrace low impact fuel cell technologies
- Fuel Cells Canada, provincial governments, and the federal government can collaborate to expand opportunities for low-impact generation

California Self Generation Incentive Program (possible program models)

Incentive Levels	Eligible Technologies	Incentive Offered ($/Watt)	Minimum System Size	Maximum System Size	Maximum Incentive Size
Level 1	Renewable fuel cells	$4.50/W	30 kW	5 MW	1 MW
	Photovoltaics	$3.50/W			
	Wind turbines	$1.50/W			
Level 2	Non-renewable fuel cells	$2.50/W	None	5 MW	1 MW
Level 3-R	Renewable fuel micro-turbines	$1.30/W	None	5 MW	1 MW
	Renewable fuel internal combustion engines and large gas turbines[1]	$1.00/W			
Level 3-N	Non-renewable & Waste Gas fuel micro-turbines	$0.80/W	None	5 MW	1 MW
	Non-renewable & Waste Gas fuel internal combustion engines and large gas turbines	$0.60/W			

FUEL CELLS CANADA

Fuel Cells Canada Sponsoring Members

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Kinectrics Inc.
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PricewaterhouseCoopers LLP
Propane Gas Association of Canada Inc.
Province of Ontario
Quebec's Fuel Cells and Hydrogen Network
Queen's RMC Fuel Cell Research Centre
QuestAir Technologies Inc.
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Sarnia-Lambton Economic Partnership
TD Securities Inc.
Tekion, Inc.
Teleflex Canada Inc.
University College of the Fraser Valley
Westport Innovations Inc.
Zongshen PEM Power Systems

Thank you
David Teichroeb
September 22, 2005
FUEL CELLS CANADA
> Accelerating Canada's World-Leading Fuel Cell and Hydrogen Industry

Supply Mix

Hydro One Presentation
to
Ontario Power Authority
September 21, 2005

Context: Major Challenges

Both short and medium term needs:

- Given the shifting supply mix and growing demand in parts of the province, transmission system investment needs to be addressed now
- Coal phase-out commitment: Substantial new supply and infrastructure ’07-’09
- Nuclear fleet aging…virtually all needs to be replaced or refurbished by 2018
- Long lead times for nuclear, hydro, transmission

Replace 80% of total existing supply by 2020 and meet growing demand

Choices re supply mix, market structure and transmission policy can have major impacts on jobs and investment in Ontario

Price Setting Fuel in Ontario

Market Opening to January 2004

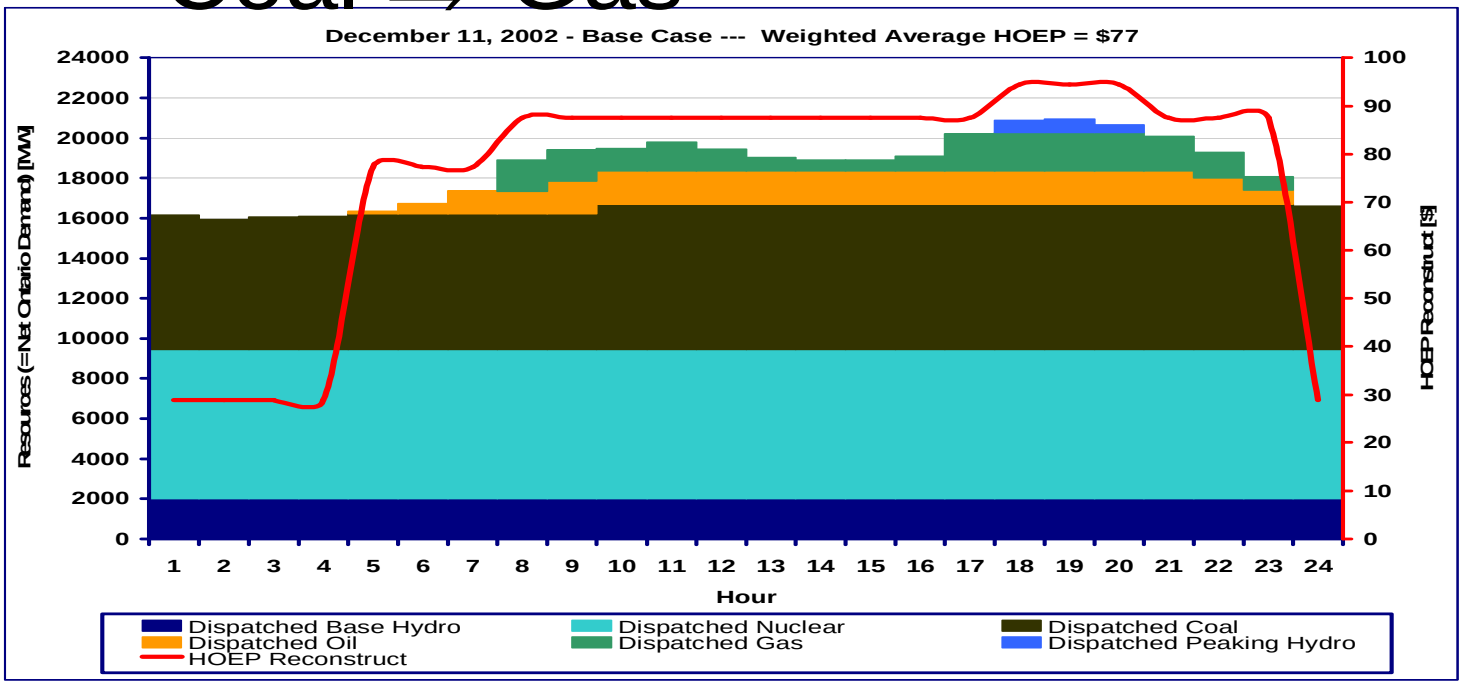
Fuel Type	Price Setting Fuel (%of time)	Average Price (cents/KWh)
Coal	56%	3.38
Gas	8.3%	7.64
Oil	22%	8.00
Uranium	0.03%	N/A
Water	15%	7.67

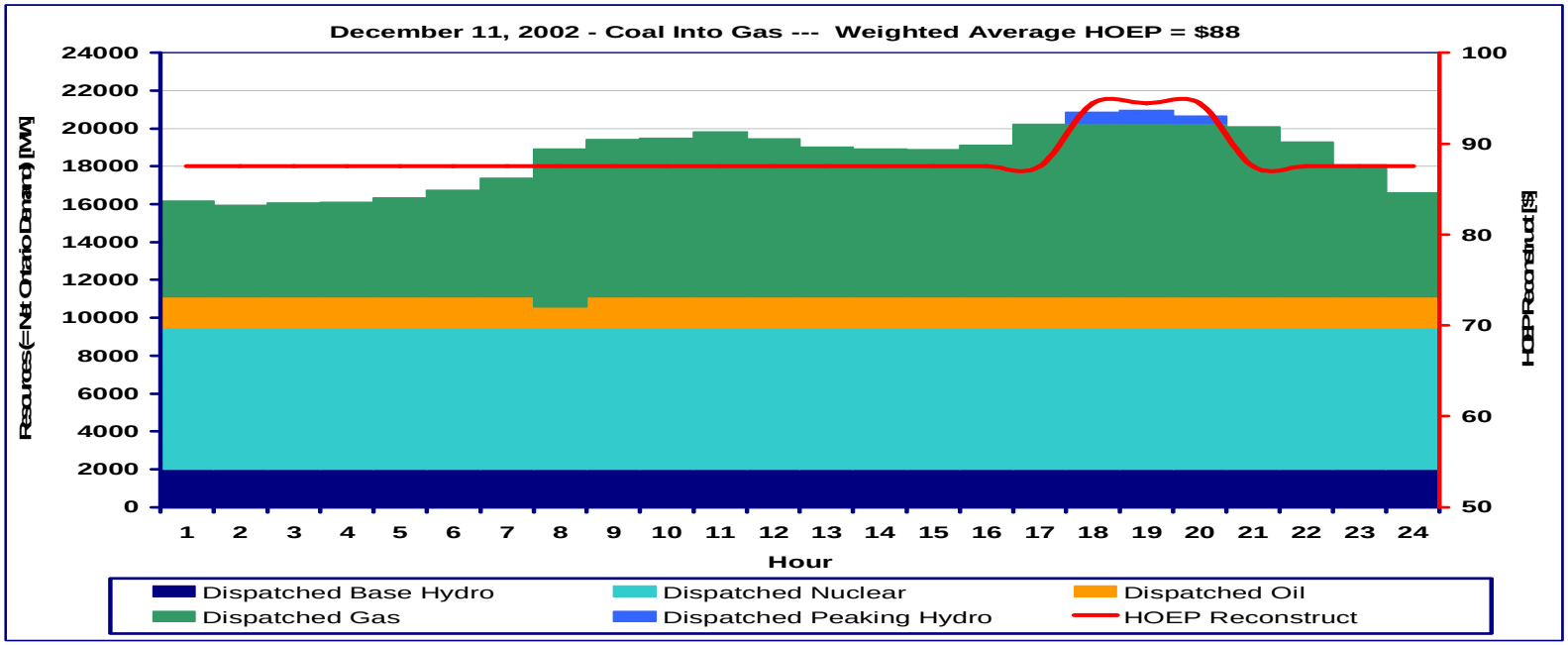
From ECSTF Final Report to Minister, January 2004)

Fuel Mix Implications

As the Electricity Conservation & Supply Task Force analysis showed, the fuel mix and pricing policies used, as coal plants are closed, will have significant impact on energy prices

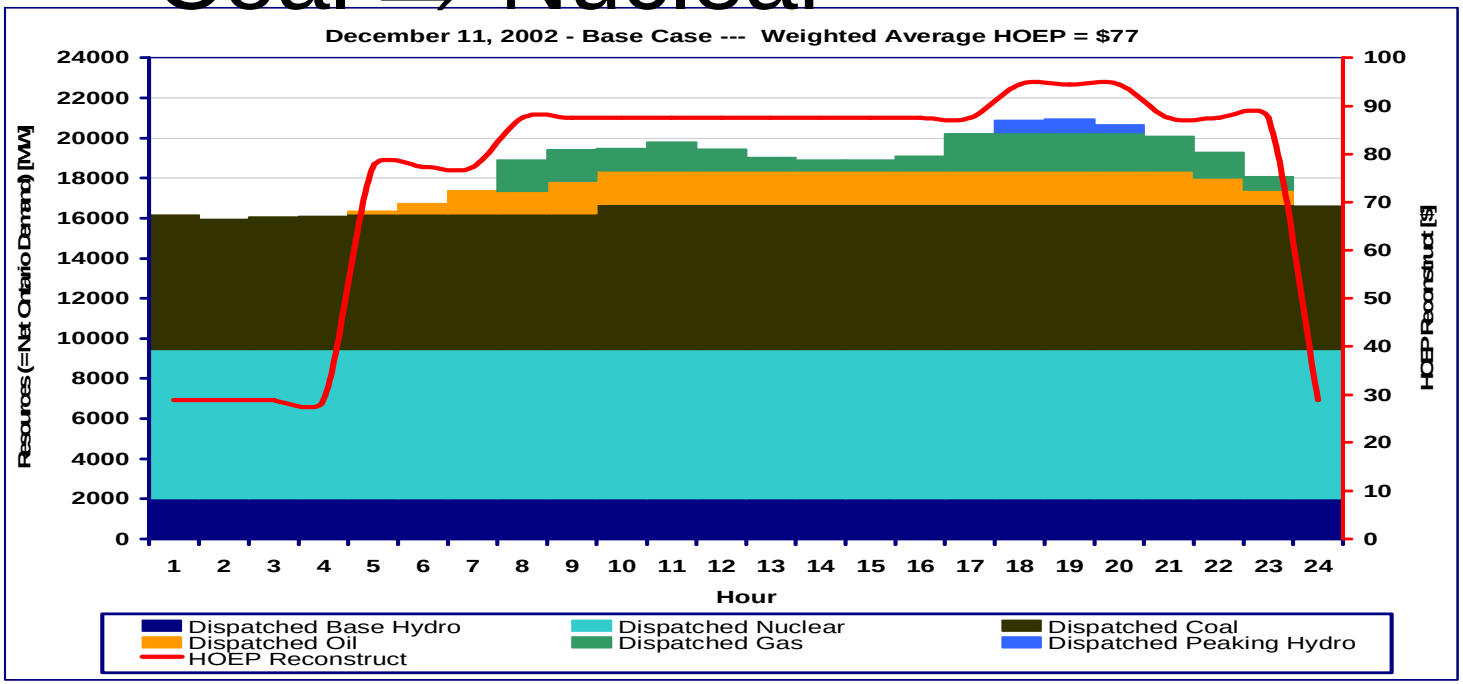
Coal ⇒ Gas

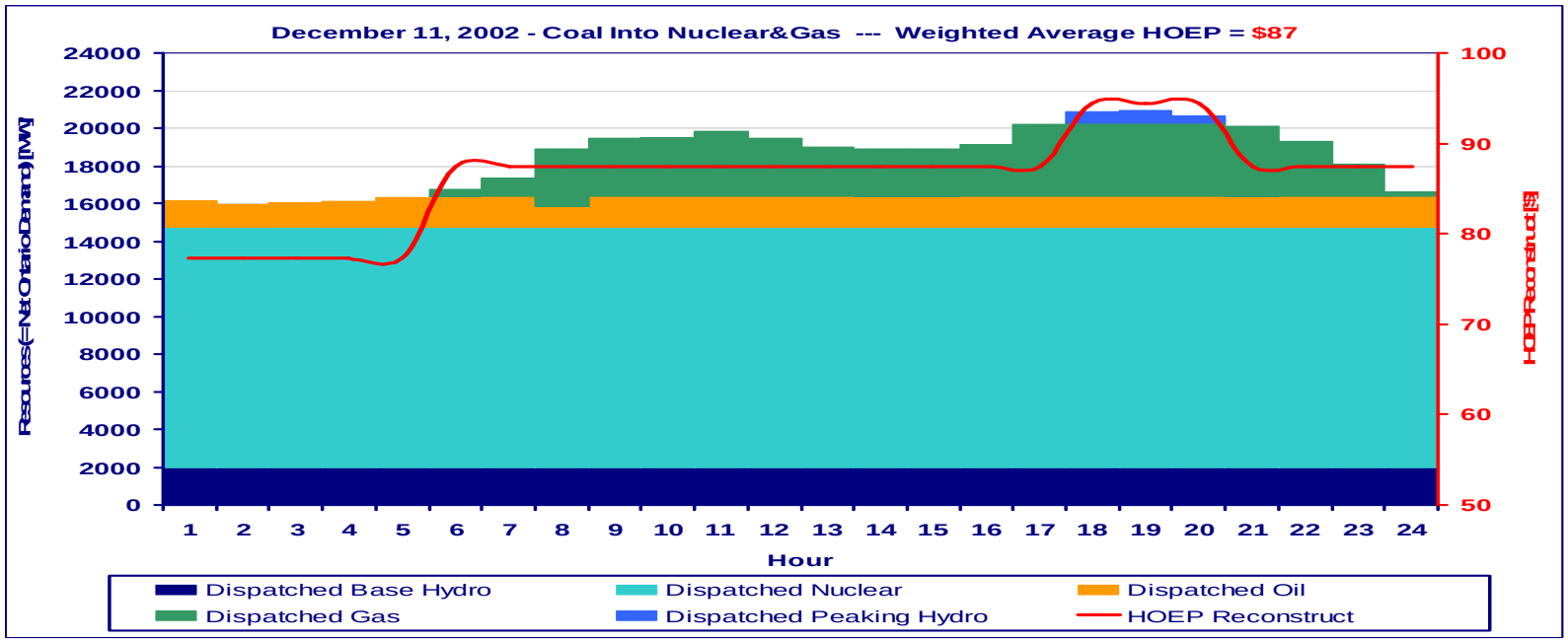




Source: EC&STF Report

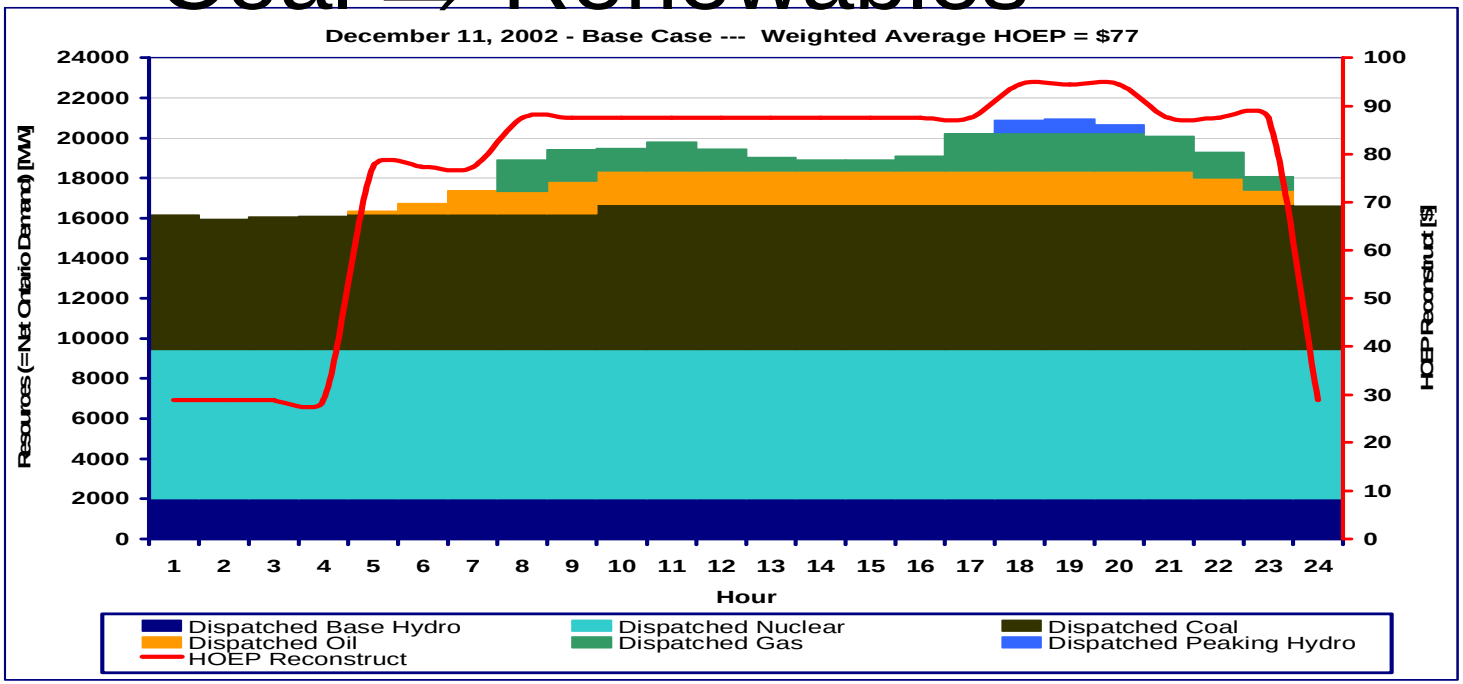
Coal ⇒ Nuclear

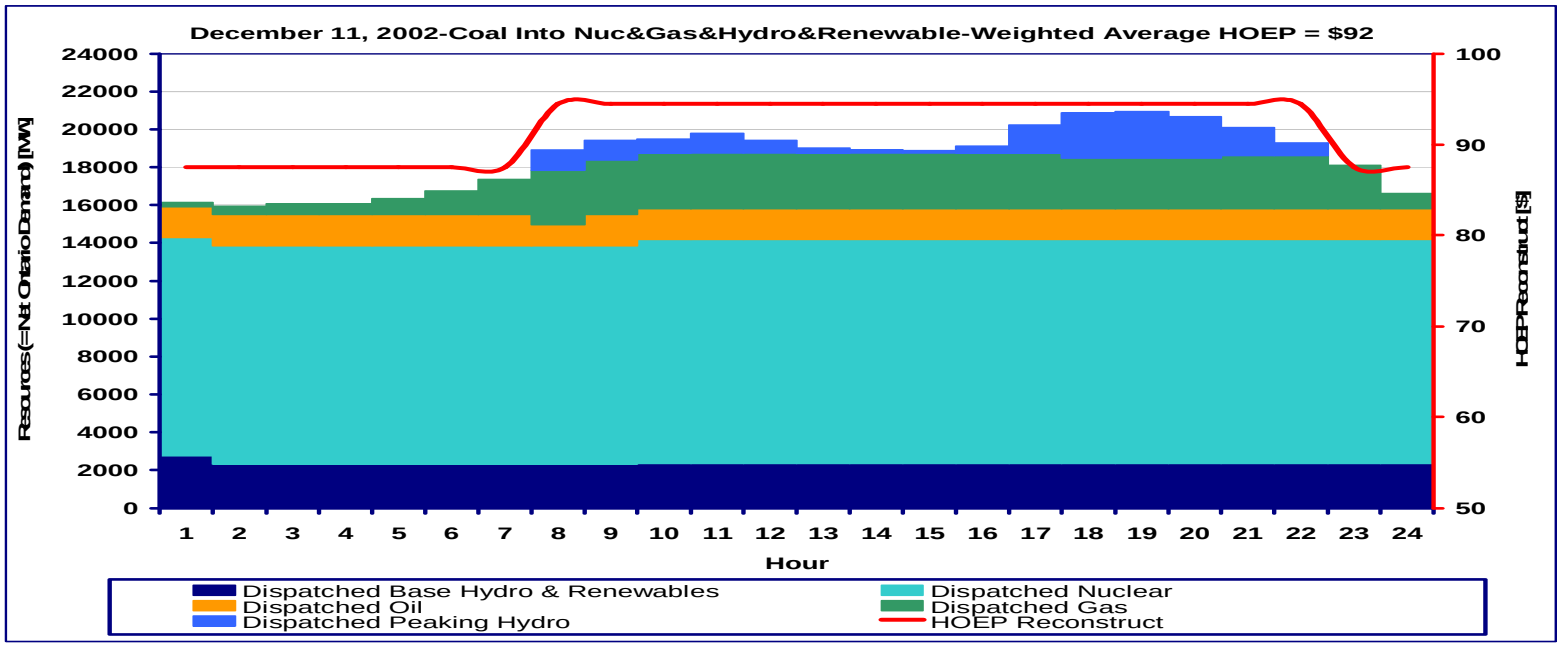




Source: EC&STF Report

Coal ⇒ Renewables





Source: EC&STF Report

LDC Delivery of Conservation

LDCs are prime delivery agents for CDM, but not the only ones.

- LDCs are the face of the industry for most customers.
- Partnerships among LDCs and with others essential for effective delivery.
- Current funding adequate for near term.
- Longer term actions require cost recovery and incentives.
- Controllable DR a major opportunity. Pilot results shortly.

Grid Investment is a Key Element

Supply Mix Impact on Transmission and Distribution

- Siting of generation options will impact Transmission / Distribution requirements
- Must consider supply mix and reliability regionally as well as provincially

Impact of Existing Transmission and Distribution on Supply Options

- Existing Transmission/Distribution offer easy connection for some options --- not for others
- Congestion impacts how supply mix options could be used

Added Investment in Grid to Optimize Supply Mix

- Grid investment should lead supply mix. No value in creating supply mix diversity and then being unable to use that diversity due to congestion.

Enhancing Ontario's Electricity Grid

Implement ECSTF recommendations for new transmission policy:

- Transmission Grid should be treated as essential public infrastructure.
- Transmission should lead generation.
- No congestion on transmission system under normal operating circumstances.
- Ontario should work with neighbouring markets to eliminate physical and regulatory barriers to trade.
- Hydro One's 10-year transmission plan continues to anticipate system expansion needs.
- With urgent need to develop new provincial electricity supply, transmission should be a facilitator of new generation; **not a barrier or competitor.**

Lessons from Others

Alberta Model:

- Transmission should not constrain or become a barrier to otherwise sound economic investment in supply infrastructure

FERC Model:

- Incentives to remove congestion barriers
- Transmission system should facilitate Open Access

National Grid Experience:

-Transmission as market enabler
- Adequate cost recovery certainty and incentives

Supply to Major Urban Centers:

- New York, Chicago, Wellington, etc.

Conclusions

Enhancing the responsiveness and reliability of Ontario's transmission grid as an objective of OPA's supply mix assessment will:

- facilitate new generation in Ontario,
- provide wider access to adjacent markets, for both imports and exports, and
- backstops conservation efforts.

Thereby, supporting retention and development of industry and jobs in Ontario.

Investigating Options for the Future of Ontario's Electricity System

Ian H. Rowlands

presentation to the
Ontario Power Authority,
Toronto, ON,
22 September 2005

University of Waterloo

Faculty of Environmental Studies

Outline

- speaker's background
- the big question(s) and the broad answer
- efficiency/conservation
- renewables
- other resources
- summary and conclusions

Speaker's Background

- Ian H. Rowlands

Employment

1998-present: Associate Professor, Faculty of Environmental Studies, University of Waterloo

1996-1997: Energy Planner, United Nations Collaborating Centre on Energy and Environment (Roskilde, Denmark)

1991-1996: Lecturer in International Relations and Development Studies, London School of Economics and Political Science

Education

1992: PhD, University of London (UK)

1987: BASc, University of Toronto

University of Waterloo

Faculty of Environmental Studies

The Big Question(s) …

What should the ‘supply mix’ for Ontario’s electricity system look like in the future …

… and how should we get there?

… and the Broad Answer

'… any consideration of the future supply mix in Ontario should prioritise conservation, followed by renewable resources, followed by conventional resources. In any case, evaluation of options should be on the basis of sustainability criteria.'

Ian H. Rowlands letter to OPA, 26 August 2005

Efficiency/Conservation

- numerous studies highlight the potential for reduction/shifting in electricity needs through efficiency (technology) and/or conservation (behavioural) actions

examples include Mark S. Winfield et al, *Power for the Future: Towards a Sustainable Electricity Sector for Ontario* (Pembina Institute and CELA, May 2004); and Ralph D. Torrie and Richard Parfett, *Phasing Out Nuclear Power in Canada: Toward Sustainable Electricity Futures* (Ottawa, ON: Torrie Smith and Associates, 2003).

- … but that is not to say that it will be easy!

Efficiency/Conservation

- to what extent would smart meters make a difference in Ontario households?

Household consumption of 1,000 kilowatt-hours a month

Used all the time	*Used with some flexibility (regarding time of use)*	*Used virtually anytime*
Refrigerator (100 kWhr) Chest freezer (100 kWhr) Clocks (10 kWhr)	Furnace fan or central air conditioning (300 kWhr) Oven (100 kWhr) Lighting (90 kWhr) Dehumidifier or heat exchange or heat-recovery ventilator (100 kWhr) TV, microwave, coffee maker, computers, etc. (85 kWhr)	Washing machine and dryer (90 kWhr) Dishwasher (15 kWhr)

key publication:
I.H. Rowlands (2004), 'Real-Time Pricing for Electricity: What Difference Could It Make to Ontario Households?', *Municipal World* (Vol. 114, No. 8, August), pp. 5-8.

- conclusion was that simple 'conservation measures' appeared more attractive

Efficiency/Conservation

- in Waterloo Region, the Residential Energy Efficiency Project (REEP) has completed over 6,000 home energy evaluations

source: www.fes.uwaterloo.ca/research/REEP/

- money encourages people to take action, but so does knowledge, time, trust, etc. … local partnerships can work to overcome barriers

key publication: Paul Parker, Ian H. Rowlands and Daniel Scott (2003), 'Innovations to Reduce Residential Energy Use and Carbon Emissions: An Integrated Approach', *The Canadian Geographer* (Vol. 47, No. 2), pp. 169-184.

Efficiency/Conservation

- analysis of two scenarios involving different strategies for demand response – namely, distributed generation (diesel or natural gas) and load curtailment

key publication: I.H. Rowlands (2005), Ontario Demand Response Scenarios, Report CTEC 2005-139 (TR), CANMET Energy Technology Centre – Varennes, Natural Resources Canada.

Impact	consumers	system operators	society
operating the generator	(D-$$$$)/(NG-$$$)		
electricity cost savings – commodity	$$		
electricity cost savings – demand	$$$		
level of services in the building			
corporate social responsibility	$		
deferred generation capacity development		$$$	
deferred transmission capacity development		$	
deferred distribution capacity development		$	
reactive power for the system as a whole		$	
lower system prices for electricity (commodity)			$$$$$
environmental changes			($)/$
economic development			$

Gains can be made, but often spread across many different players

Efficiency/Conservation

- ongoing work: proposal being developed …
  - The purpose is to understand how Ontario could improve the sustainability of its electricity system through the increased use of ‘demand response’ – that is, demand-side (or customer-level) activities that serve to reduce system-wide peak demand for power.
    - 1) What is the value of demand response in Ontario?
    - 2) How has demand response developed in Ontario to date, and how could it continue to develop in the future?
    - 3) What impacts upon sustainability would different demand response policy options in Ontario have?
    - 4) How do different kinds of customers in Ontario respond to various demand response prompts?

Renewables

- generally, among supply options, the most benign in terms of environment and/or sustainability
- life-cycle analyses show this
- aggregated measures like the ‘Power Scorecard’ reveal this as well

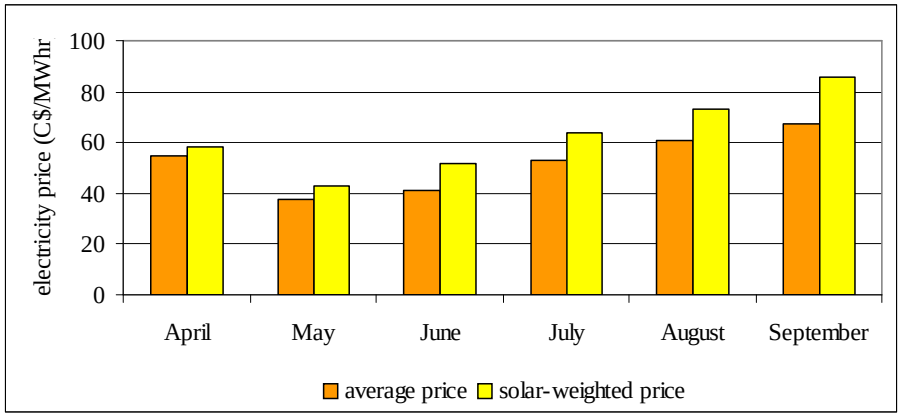
http://www.powerscorecard.org

- but their use will not be automatic!

Renewables

- study on the ‘value’ of solar electric power
  - the coincidence of peak demand and peak price periods means that solar electricity is more valuable than the ‘average kWhr’ produced by the system

Average monthly electricity prices, Ontario



key publication:
I.H. Rowlands (2005), ‘Solar PV electricity and market characteristics: two Canadian case-studies’, *Renewable Energy*, 20:815-834.

Renewables

- Why do some businesses voluntarily buy (premium-priced) ‘green power’ while others do not?

source: www.fes.uwaterloo.ca/research/greenpower/

- importance of an internal champion motivated by individual values
- linking this to a business issue within the company, often through a business strategy or culture that recognises that environmental ‘value’ can come in many different forms

key publication:
T. Berkhout (2005), ‘The Voluntary Adoption of Green Electricity by Ontario-Based Businesses’, University of Waterloo, Department of Environment and Resource Studies, MES Thesis.

Renewables

- policies to encourage increased use of renewables
  - experience in Europe reveals the success of ‘feed-in tariffs’
  - in Ontario, not only is their cost not as high as perhaps initially envisaged, but by encouraging ‘learning by doing’, rapid cost reductions can result

key publication:
I.H. Rowlands (2005), ‘Envisaging feed-in tariffs for photovoltaic electricity: European lessons for Canada’, *Renewable & Sustainable Energy Reviews,* 9:51-68.

Renewables

- ongoing work: research being conducted …
  - ‘valuing’ renewables
    - using methods from environmental and ecological economics to investigate the ‘costs’ (and broader ‘value’) of systems that provide electricity services

http://www.externe.info/

Other Resources

- other resources' contributions (indeed, all resources' contributions) should be judged against criteria for sustainability:

'Three-legged stool' approach:

-environmental

-economic

-social

source: www.clipart.com

key publication: R. Gibson et al (2005), *Sustainability Assessment* (London: Earthscan).

Principles for sustainability:
-integrity
-sufficiency and opportunity
-equity
-efficiency
-democracy and civility
-precaution and adaptation
-integration

Summary and Conclusions

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Tel: (519) 888-4567, ext. 2574

ieso
Power to Ontario.
On Demand.

OPA Supply Mix Consultation
IESO Comments

Presentation by Derek Cowbourne and Don Tench

October 5, 2005

Summary of IESO Supply Mix Submission (August 26, 2005)

- Close co-ordination between the OPA and the IESO will be essential to ensure that the future supply mix will meet Ontario's reliability needs across all timeframes.

- A secure, reliable supply and the ability to operate effectively in the markets should be the primary objectives of any supply portfolio for Ontario.

Summary of IESO Supply Mix Submission (August 26, 2005)

- Ontario's overall supply plan should be:
  - robust to ensure adequate supply of capacity and energy
  - balanced to mitigate the risks inherent in each technology and fuel type
  - responsive to change
- The resulting resource mix must:
  - enable operational flexibility by providing the appropriate ratio of characteristics required to maintain reliability
  - consider deliverability and dependability of each resource type to determine contribution to capacity and energy requirements
- Construction of the portfolio must consider:
  - the impact on operations, operational flexibility must be maintained
  - the structure of any OPA contracts used to procure supply; this can be just as impactive as the physical characteristics of the units

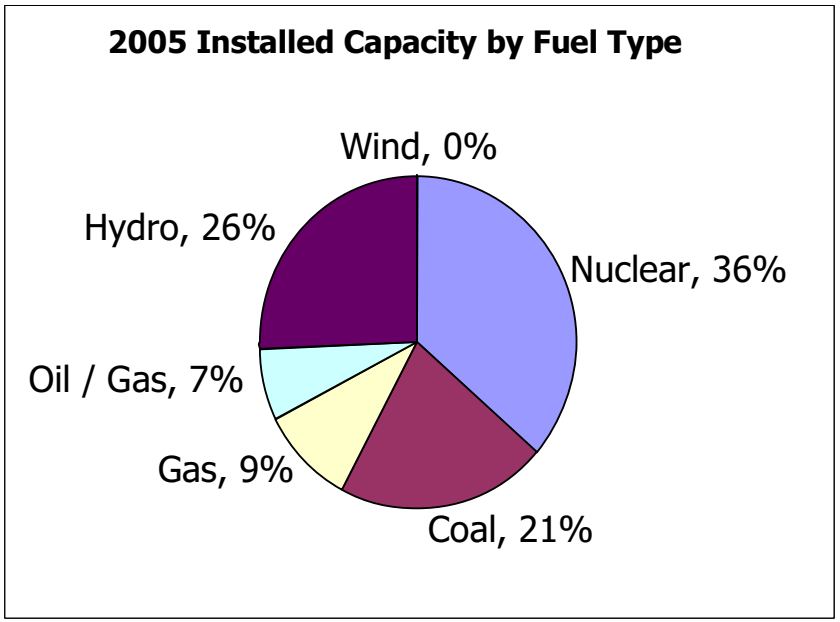
Scope of Today's Presentation

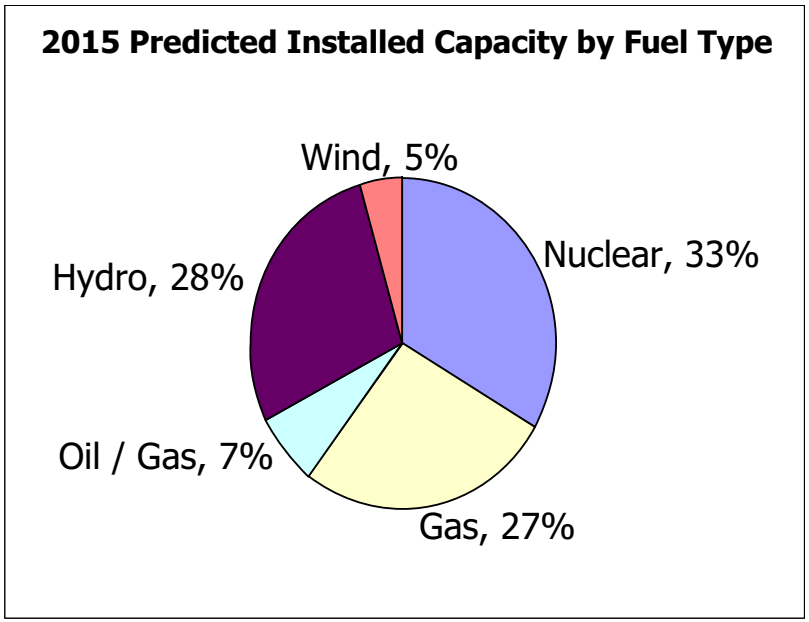
- This presentation builds on our prior Supply Mix submission by providing advice specific to the characteristics the resource mix must provide to ensure sufficient operational flexibility.
- This presentation begins to identify quantified, forecast data to support the advice.
- Before finalizing such data, and to ensure that we provide you with appropriate data, we would appreciate a better understanding of the expected scope of the OPA's December 1 supply mix report (i.e. how can we best help you?).

Changes Affecting Supply Mix

- The key factors affecting supply mix requirements are undergoing significant changes.
  - Policy is changing the types of resources that will be available to Ontario.
  - Ontario's load shape is changing from a winter peak to a summer peak, creating a new profile for the peak.
  - Weather variability is changing from year to year, impacting the peak and the minimum demands.

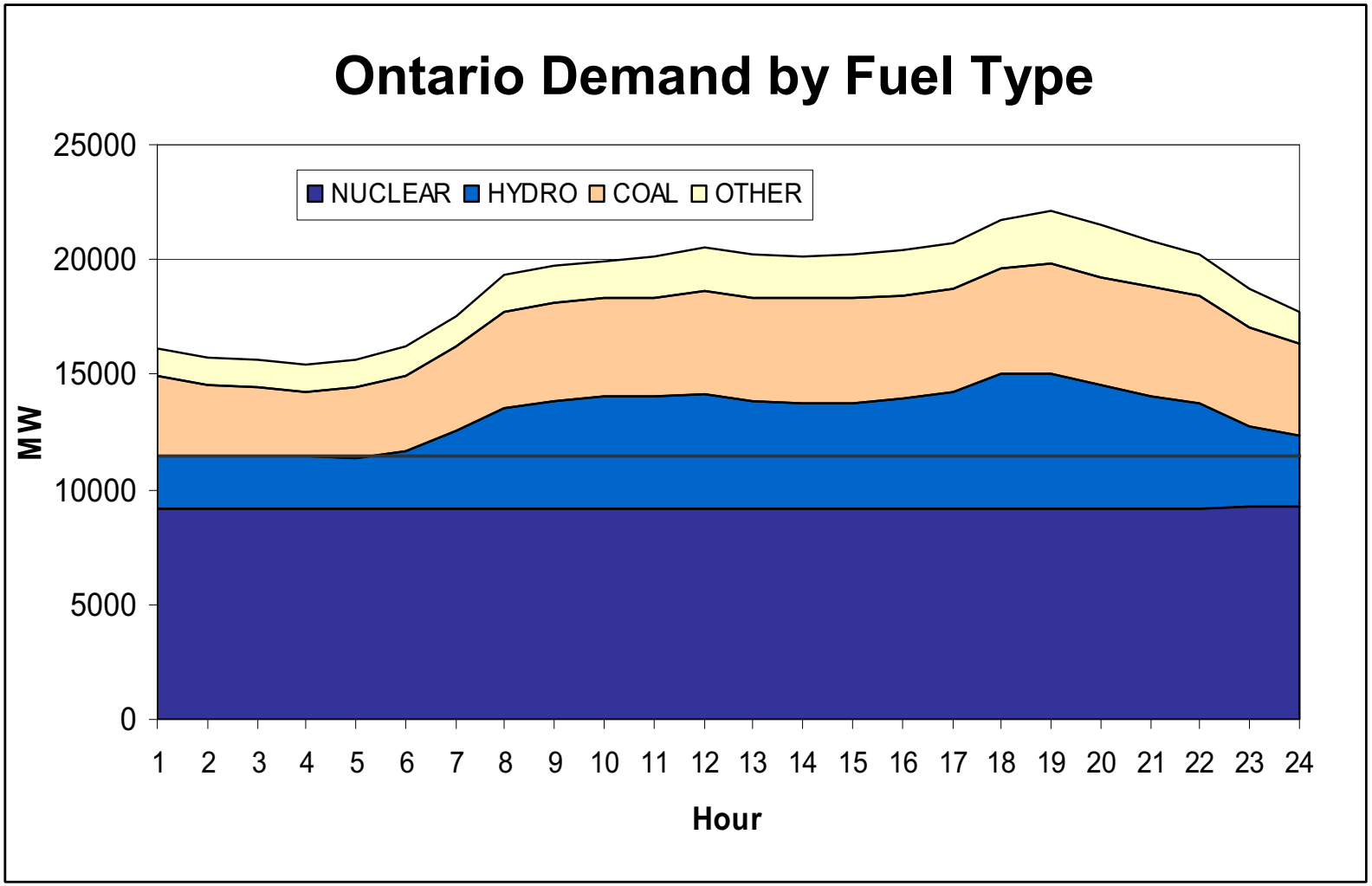
Fuel Mix Scenario: 2005 and 2015 Coal Replacement



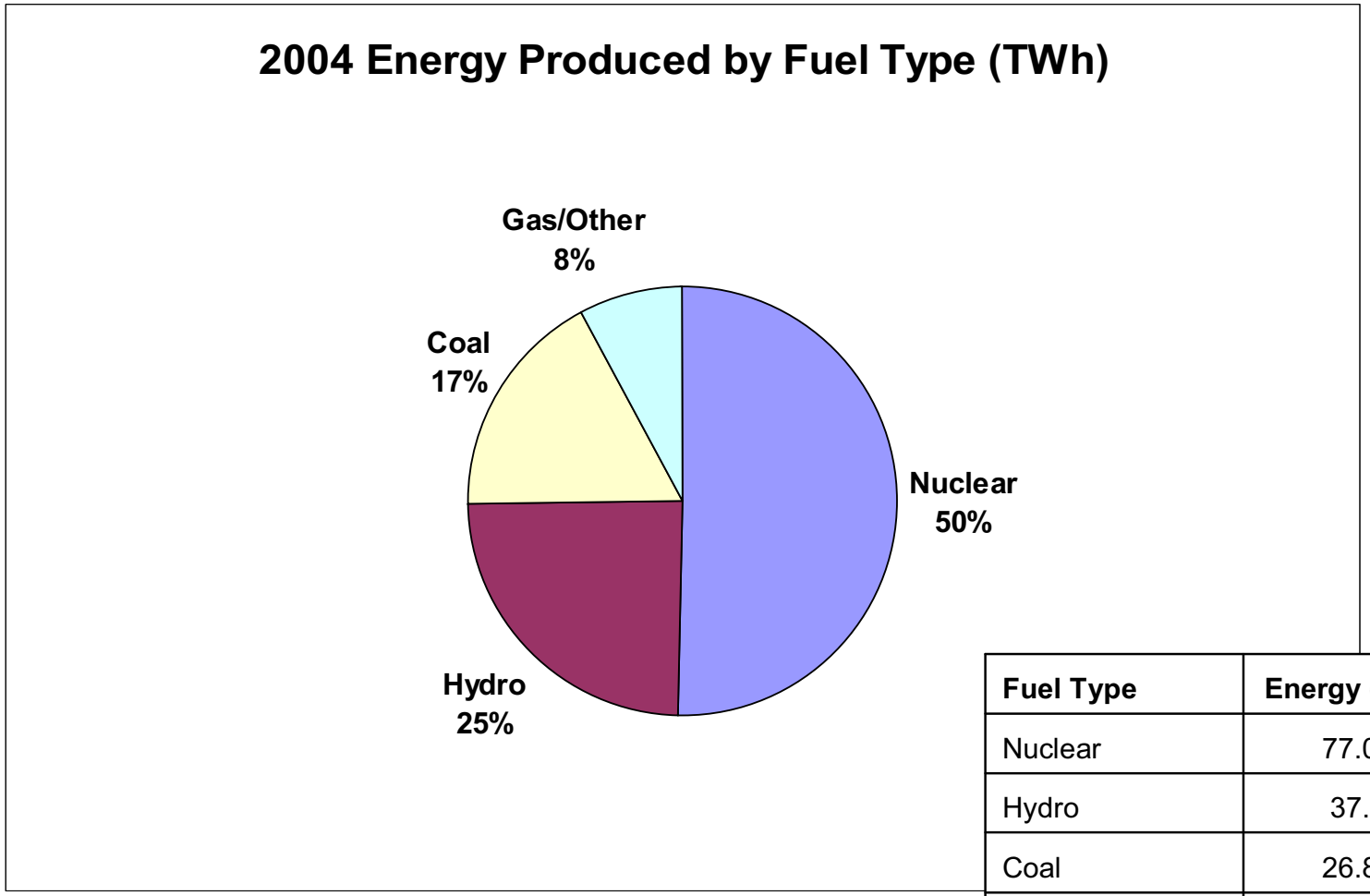


- IESO's 10-Year Outlook (July 8, 2005) forecast the fuel mix using the assumption that all coal-fired generation would be replaced by cleaner sources of supply, as has been directed by the government. The 2015 predicted mix does not reflect the supply gap predicted for that year.

Supply Profile: January 10, 2005



Energy Produced by Fuel Type



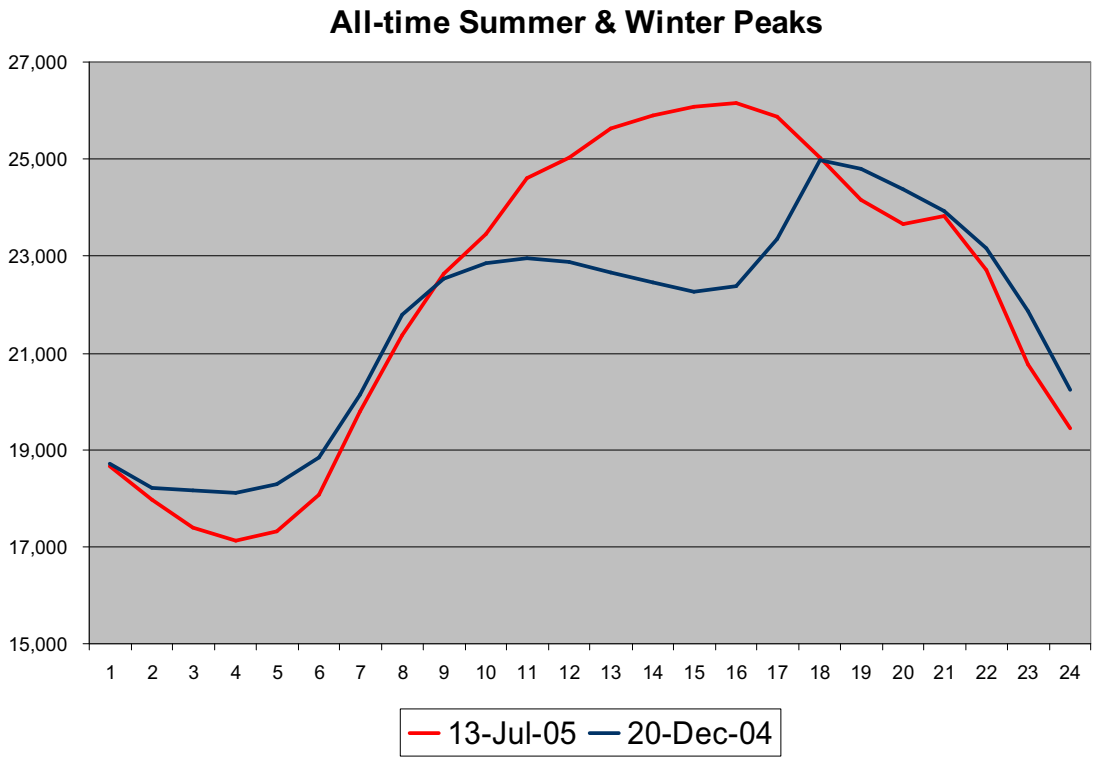
Fuel Type	Energy (TWh)
Nuclear	77.03
Hydro	37.6
Coal	26.83
Gas/Other	11.88

Factors Influencing Demand Shape

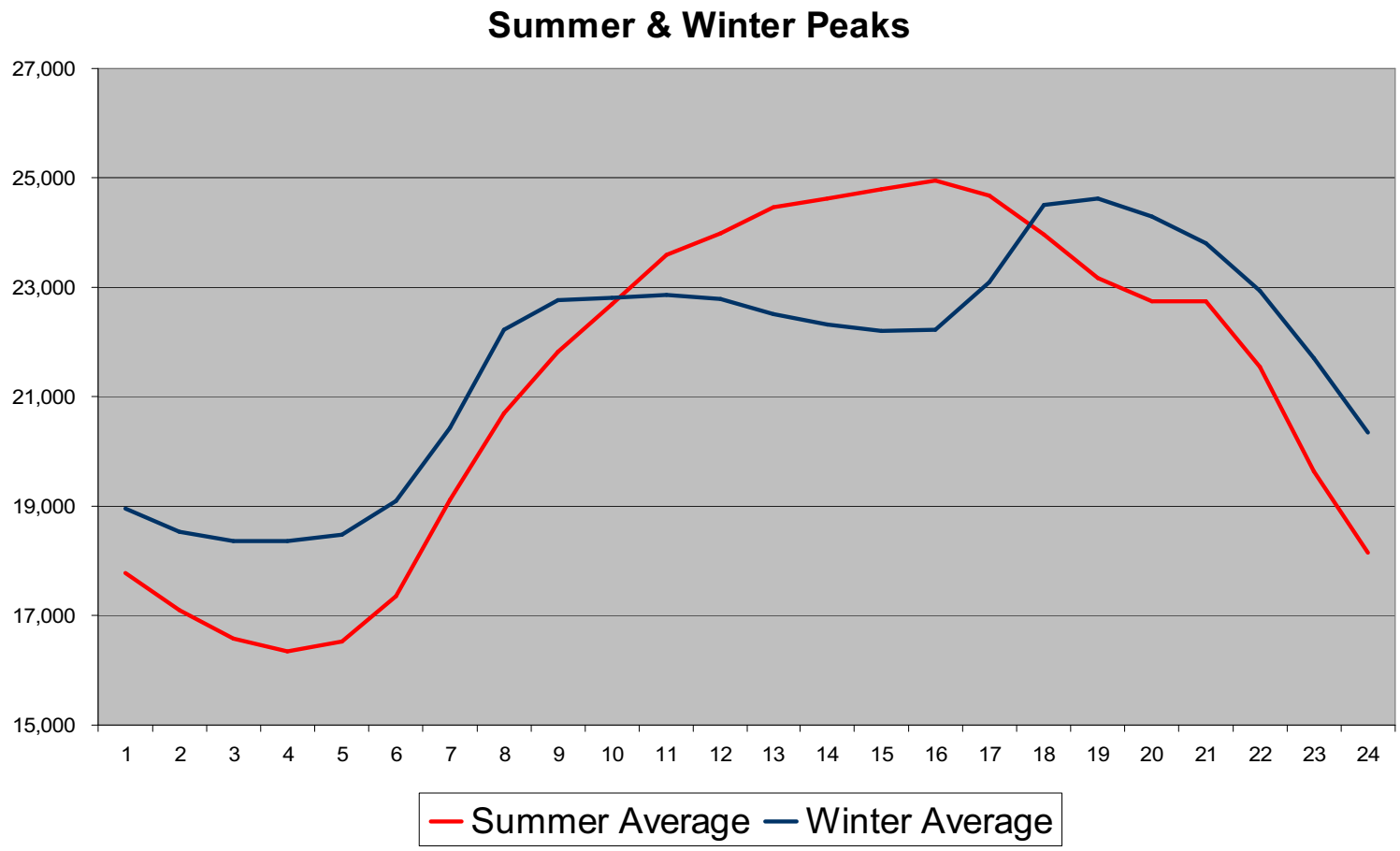
FACTOR	RESULT	IMPACT ON MINIMUM LOAD	IMPACT ON MAXIMUM LOAD
Demand Management	Load-shifting from peak to off-peak	Higher minimum ↑	Lower peak ↓
Demand response	Increase load available to be dispatched off	N/A	Lower peak ↓
Conservation	Lower overall load requirement	Depending on source may lower minimum ↓	Depending on source may lower peak ↓
Distributed Generation	May act like baseload resources unless directed otherwise	Lower minimum (dependent on technology) ↓	Lower peak ↓
Technology Improvements	Various	More flexible nuclear resources may allow increase in installed baseload capacity	A/C efficiency could lower summer peak; lighting efficiency could lower winter peak ↓
Baseload Maintenance Requirements	Fewer baseload resources available	No change, but may allow increase in installed baseload capacity	N/A

Summer vs. Winter Peaks

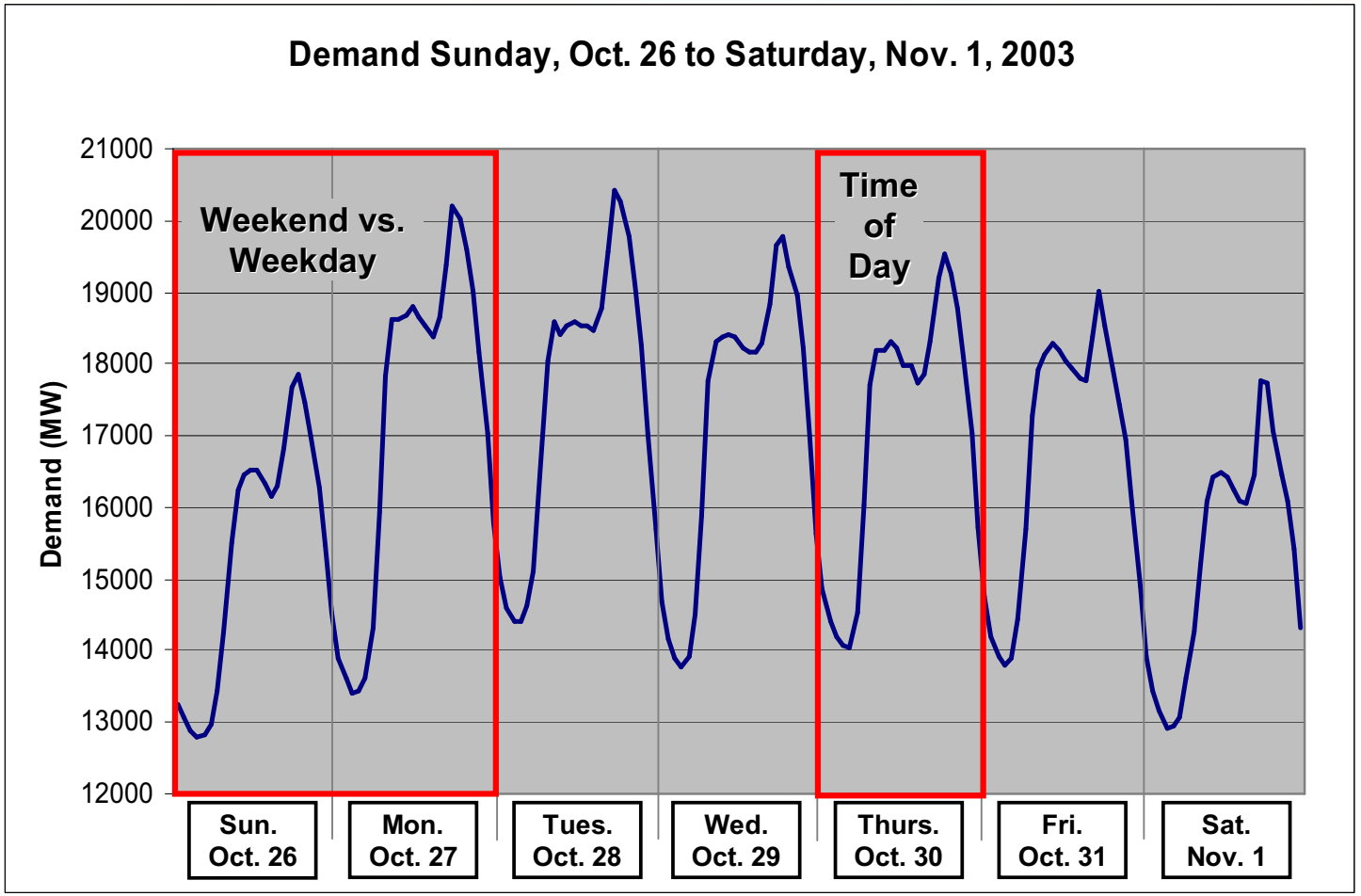
- Summer typically has longer peaks with larger ranges between peak and minimum.
- Winter typically has shorter peaks with smaller ranges.
- Extreme summer peaks typically have a higher energy component than extreme winter peaks.
- Supply mix must accommodate both, and recognize performance limitations resources can experience in the summer.



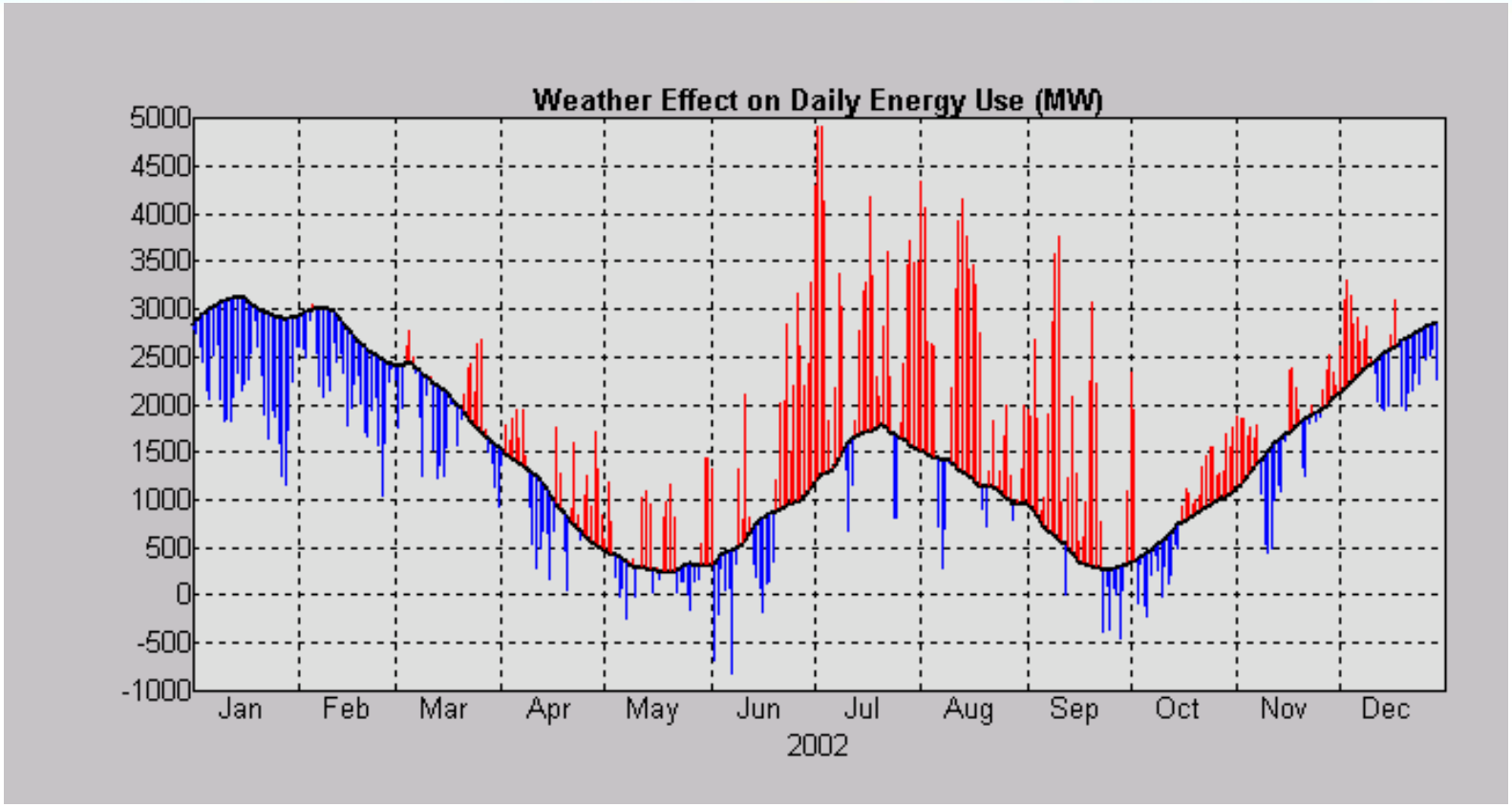
Average Peaks



Demand Varies with Time

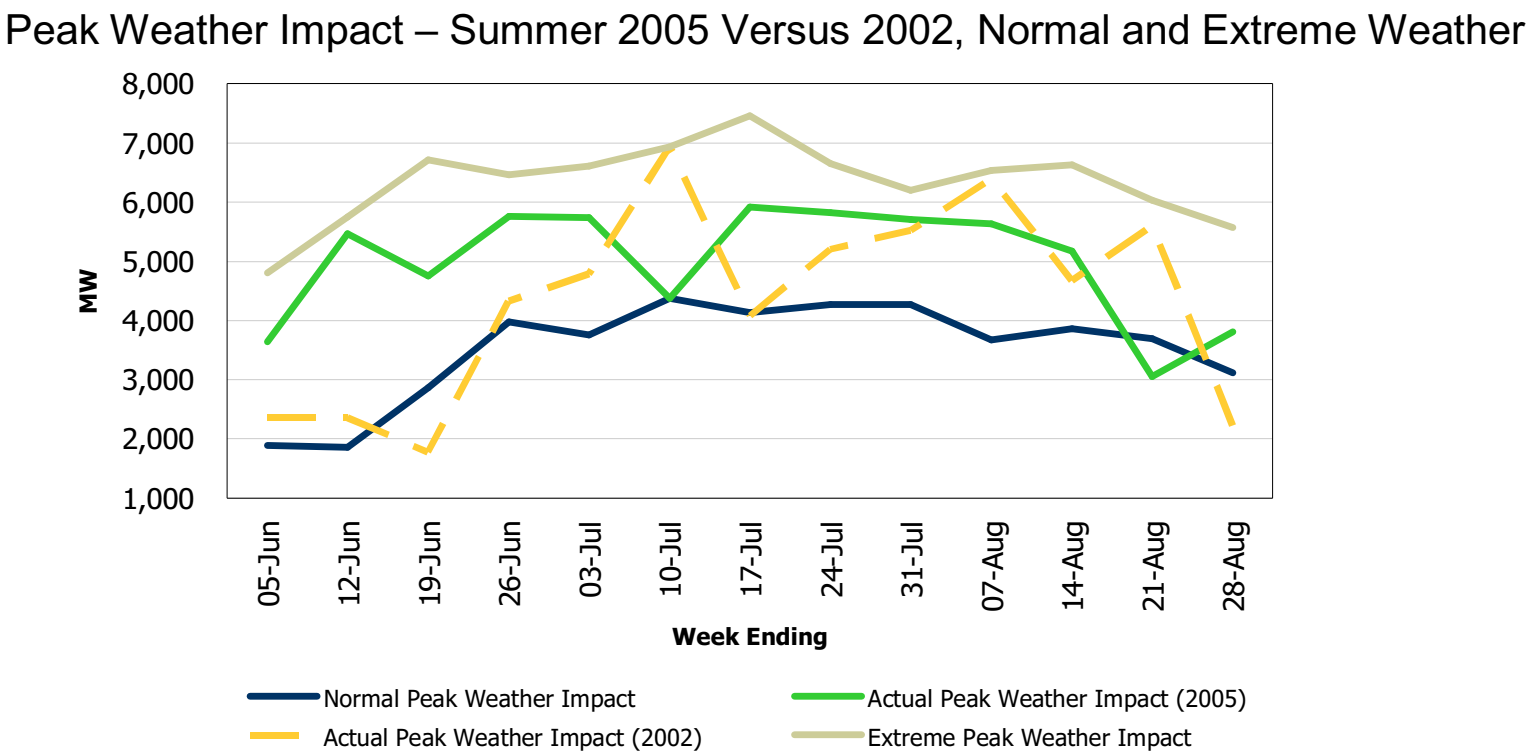


Demand Varies with Weather



- Weather has, by far, the largest influence on demand. Statistical analyses have shown that about 40% of the variability in demand is the result of weather.

Peak Weather Impact (2005 Q3 18 Month Outlook)



- The summer of 2005 was consistently hotter than 2002, but the summer of 2002 displayed a much more volatile pattern with periods of mild and extreme weather.

Ratio of Resources

- Ontario's current supply mix is approximately 50% baseload and 50% intermediate/peaking generation.

- Baseload generation has traditionally included nuclear and some hydro-electric resources.

- Intermediate and peaking generation typically include coal, hydro-electric (with pumped storage) and natural gas-fired resources. It is difficult to distinguish between these two classifications as some resources are capable of providing both types of response.

Resource Types and Operational Characteristics

Characteristics / *Resource Types*	Supply Type	Load Following Capability	Operating Reserve	Black Start Service	Reactive Support	Automatic Generation Control
Natural Gas – Single Cycle	Intermediate or Peaking	Good	Good	Good	Good	Good
Natural Gas – Combined Cycle	Intermediate	Good	Good	Moderate	Good	Moderate
Cogeneration	Baseload	Poor	Poor	Moderate	Good	Good
Nuclear	Baseload	Poor	Poor	Poor	Good	Poor
Hydro-Electric (including pumped storage)	Peaking	Good	Good	Good	Good	Good
Hydro-Electric (Run of River)	Baseload or Intermittent	Poor	Poor	Good	Good	Poor
Clean coal (coal gasification, fluidized bed, etc.)	Intermediate	Good	Good	Good	Good	Good
Wind	Intermittent	Poor, only through constrained operation	Poor, only through constrained operation	Not applicable	Moderate	Not applicable
Biomass	Variable, depending on fuel source	Good	Good	Moderate	Good	Moderate
Demand Response	Intermediate or Intermittent (voluntary programs)	Moderate	Good	Not applicable	Not applicable	Not applicable
Demand Management	Intermittent	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Interconnections	Intermittent or Peaking (emergency purchases)	Moderate with appropriate market transactions in place	Good	Moderate to good (provided not blacked out)	Poor, support is localized to points of interconnection	Moderate to good

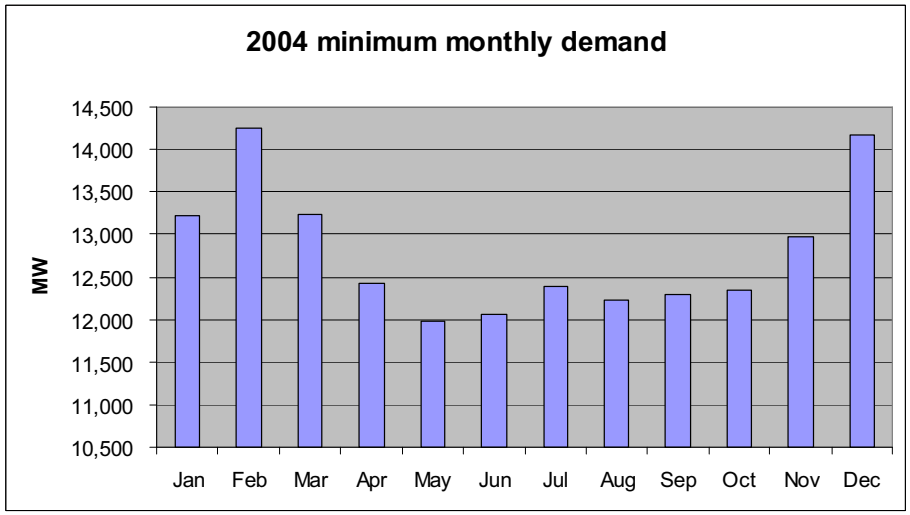
Ratio of Resources

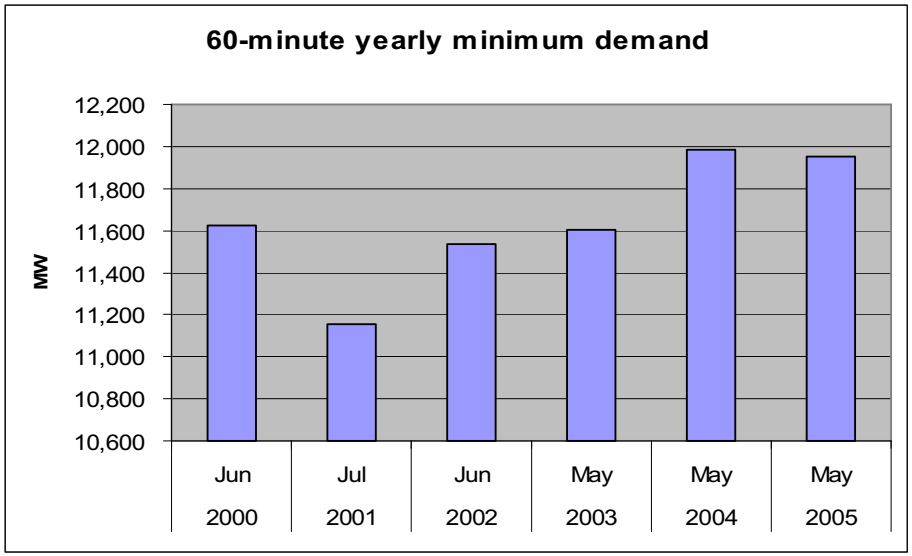
- As Ontario's load shape evolves, as existing technology changes, and as new technology becomes available, it will become increasingly difficult to classify resources by fuel type as providing baseload, intermediate or peaking generation.
- It may be more appropriate to define the ratio of characteristics required rather than the ratio of certain fuel types required.
- Baseload generation could then be translated to "generation at times of minimum demand".
- Intermediate and Peaking generation could be represented by the need for load following capability and even quick start capability.
- Also need to consider the need for required ancillary capabilities: operating reserves, load balancing, Automatic Generation Control (AGC), frequency control, voltage support and black start.

Generation at times of Minimum Demand

- Amount of inflexible supply available at any time cannot exceed minimum demand.

- Inflexible supply may include what has traditionally been referred to as "baseload" but is essentially any resource that is designed to run "full-out" and does not have the flexibility to respond quickly and easily to demand changes.





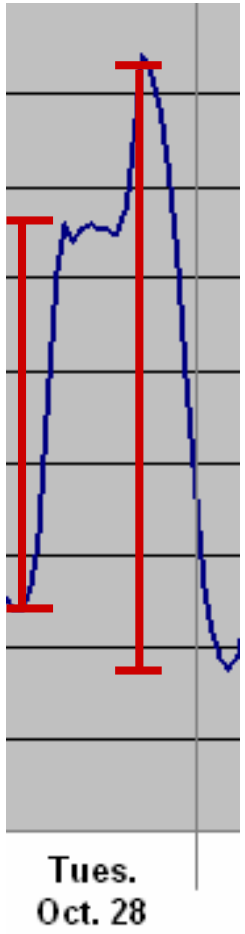
Inflexible Supply

- The maximum amount of installed inflexible supply should account for:
  - All inflexible resources, including intermittent and co-generation
  - Unit outages,
  - Contract terms impacting availability,
  - Load following capability required at times of minimum demand. This need will increase with increasing amounts of intermittent generation.

- Ability to export may provide a buffer if available inflexible supply exceeds demand, but there is no guarantee.

Load Following Capability

- Demand continuously varies (range of 5,000 to 10,000 MW from valley to peak and back).
- The ramp rates needed to maintain the supply/demand balance over the morning and evening peaks can be significant (up to 50MW/minute for 3 – 4 hours).
- Imports and exports are ramped over a 10 minute period each hour, which add up to 70 MW/min in addition to the normal Ontario demand pickup rate.
- Must consider the operating range of available supply technologies to determine the optimum mix.



Alternative Resource Implications

- As Ontario incorporates an increasing quantity of renewable and other alternative resources the following implications should be considered:
  - It will take time to accurately predict availability of some new technologies due to lack of local experience and historical data.
  - Monitoring of embedded, distributed and aggregated resources may be necessary to ensure reliability and dispatch flexibility.
  - Alternative resources that are not dispatchable may be "baseload" generation.
  - Creative solutions should be employed to make the most of alternative resources. For example: wind energy could be partnered with suitable loads or generation facilities (such as hydroelectric) to co-optimize both elements of supply.

Transmission Policies

Role of transmission:

- Transmission should always be one of the available options for resolving local area issues.
- Transmission additions should provide maximum benefit to Ontario, not just address specific issues.
- Transmission must be designed to meet NERC planning and operating standards.

Cost of required transmission additions:

- Transmission costs should be factored into the competitive evaluation of generation options.
- Transmission additions providing provincial benefit should be paid for by all consumers once a project is in service; a project should only be required to pay connection costs.

In general, policy should facilitate investment in generation and transmission infrastructure.

Summary

- Over the next 20-30 years the extent to which each of the operational characteristics are required and the way in which we satisfy these requirements will change.

- It will be essential that the Integrated Power System Plan and the resource mix provided allows for these changes.

- The IESO is committed to working with the OPA to meet this challenge.

OPA Meeting
21 September 2005, 9:00 – 10:00 am

Stan Pejovic and Bryan Karney

Civil Engineering Department, University of Toronto

STABILITY OF PRICE AND POWER PRODUCTION OF CLEANER ELECTRICITY IN ONTARIO

Supply Mix

Best Efficiency – Free Spinning Reserve - Stability

Prof. Bryan Karney, Ph.D., P.Eng.

E-mail: karney@ecf.utoronto.ca

Good morning.

My name is Bryan Karney

I am a Professor of Civil Engineering, U. of Toronto, Associate Chair (Graduate Studies).

We value the opportunity to express our views here today.

The Context

- Historically, perhaps looked for dominant solutions to pressing problems
- Current challenges huge.
  - Balancing public good with private incentives
  - Huge social and environmental constraints
  - Need for multiple strategies and assessing vested interests
  - Classical trade-offs between short-term and long-term interests

- Princess: “But you caused me pain!”
- Wesley: “Life is pain, Highness. Anyone who says differently is selling something.”

- *Princess Bride*

Submission 1:

Electric Generators Profit/Costs On-Line Management and Control.

Stan Pejovic, Bryan Karney, Andrew Colombo, and Qinfen Zhang, University of Toronto.

We offer to be team members or lead a private team.

Attachment 1: Short description: Electric Generators Profit/Costs On-Line Management and Control.

Attachment 2: Case, Descriptions of Electric Plant Optimisation: Hydroelectric Generators Profit/Costs On-Line Management and Control

Submission 2:

Supply Mix

We have hosted talks at the University of Toronto.

Submitted documents in response to Bill 100.

Not our goal to stir up trouble!

We would ideally like to be part of the solution in moving things forward.

We are independent of specific proposed solutions, but have great motivation and experience.

Submission 2:

Supply Mix

Willingness and interest to perhaps be part a subsequent or follow-up study.

Participate in the review process, particularly should a fully non-partisan opinion by people with considerable technical background, be of interest to you.

Attachment 3: Written Submissions on Supply Mix < Pejovic Karney Supply Mix.doc>

Content

- Context of energy systems
- Optimisation
- Supply mix
- Hydro power and pumped storage plants
- Role with renewable energy
- Nuclear plants
- Nuclear/coal combined with pumped-storage

Context of Energy Systems

- Energy – of universal significance
- Requires a comprehensive approach!
  - Includes production/generation capacity
  - Transmission line capacity
  - Aggressive conservation measures
  - Appropriate pricing
  - **Consideration of stability and reserves**
  - All working together …

Significant Function: Load Leveling.

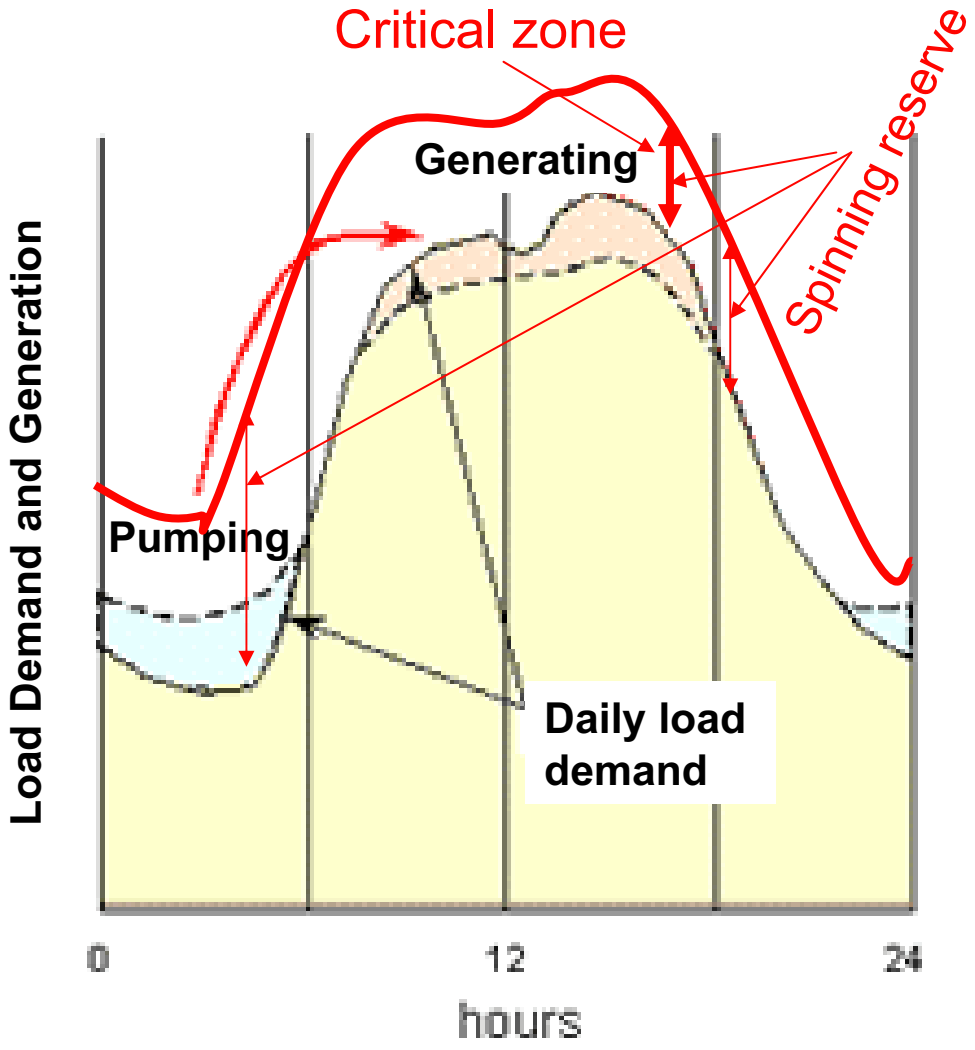


Figure 2 Load demand and generation

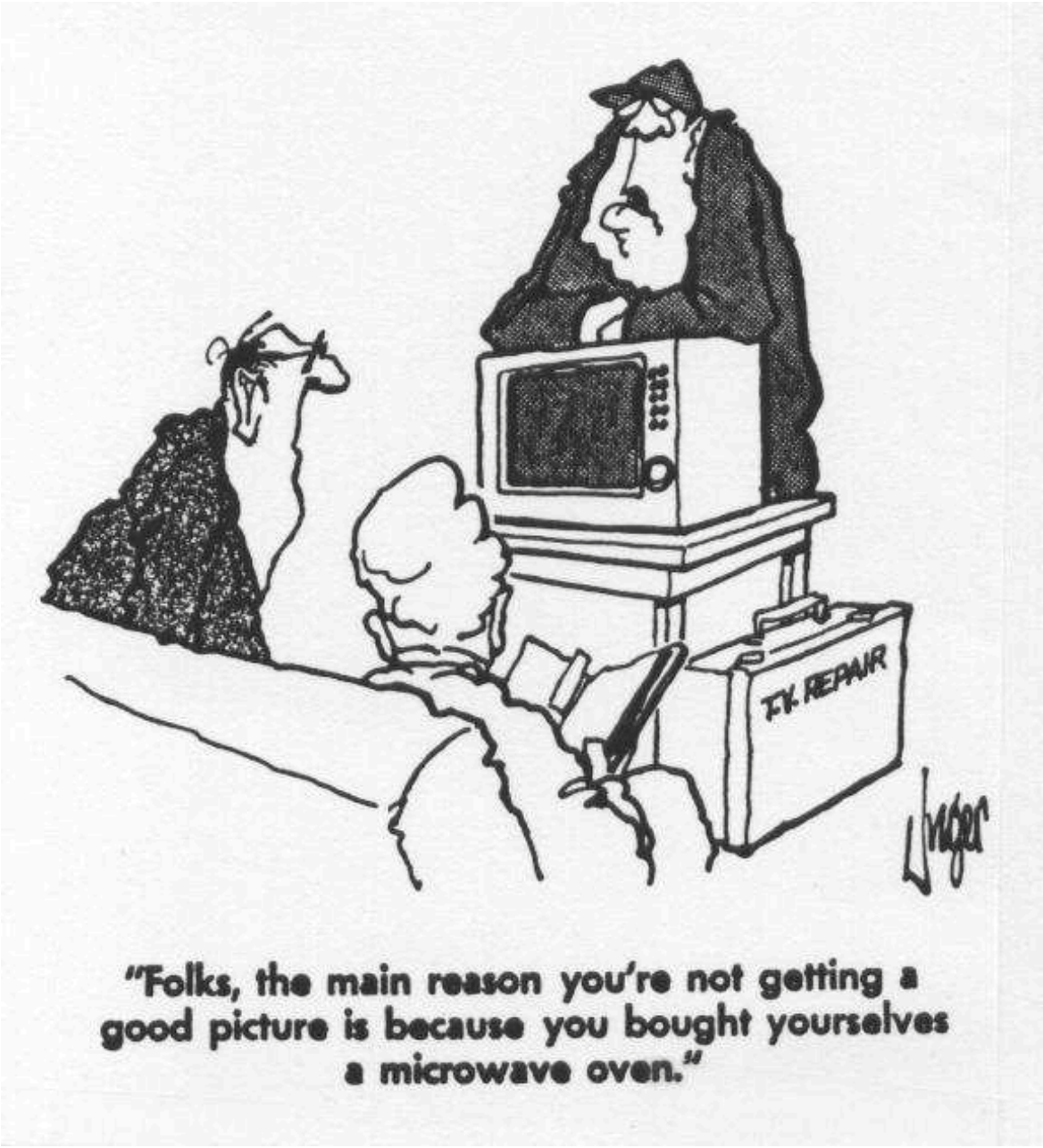
Absorbs surplus power from the grid during the off-peak period, by pumping water to upper reservoir.

In peak period, generates power using the stored water, thus leveling the load for other generating plants.

Hydrogen only absorbs surplus

Hydro Plants

- Every method of production has strengths and weaknesses
- Both hydro power plants and reversible pumped-turbine storage electric plants
  - Have superb attributes for meeting peak demands
- Desirable characteristics include
  - Fast and flexible response to load changes
  - Clean energy
  - Long life (sometimes even 100 + years)
  - High efficiencies



"Folks, the main reason you're not getting a good picture is because you bought yourselves a microwave oven."

History

- Load Leveling – original reason why pumped storage plants were built
  - Both daily and seasonal adjustments
- Pumped hydro first used in Italy and Switzerland in 1890's.
- By 1933 reversible pump-turbines with motor-generators were available.
- Adjustable speed machines introduced (1990)
  - Improve efficiency (10%) and
  - Reduce operation costs (50%).

Similarities and Differences

- Conventional hydropower plants also store and release energy as needed
- Quite common for hydro-power plants to be used primarily for peak demands
- Excellent for this purpose:
  - Capable of being started and stopped quickly, easily and at little cost.
- But they also require considerable water flow and water storage
  - Large upper reservoir and sustained yields from catchment

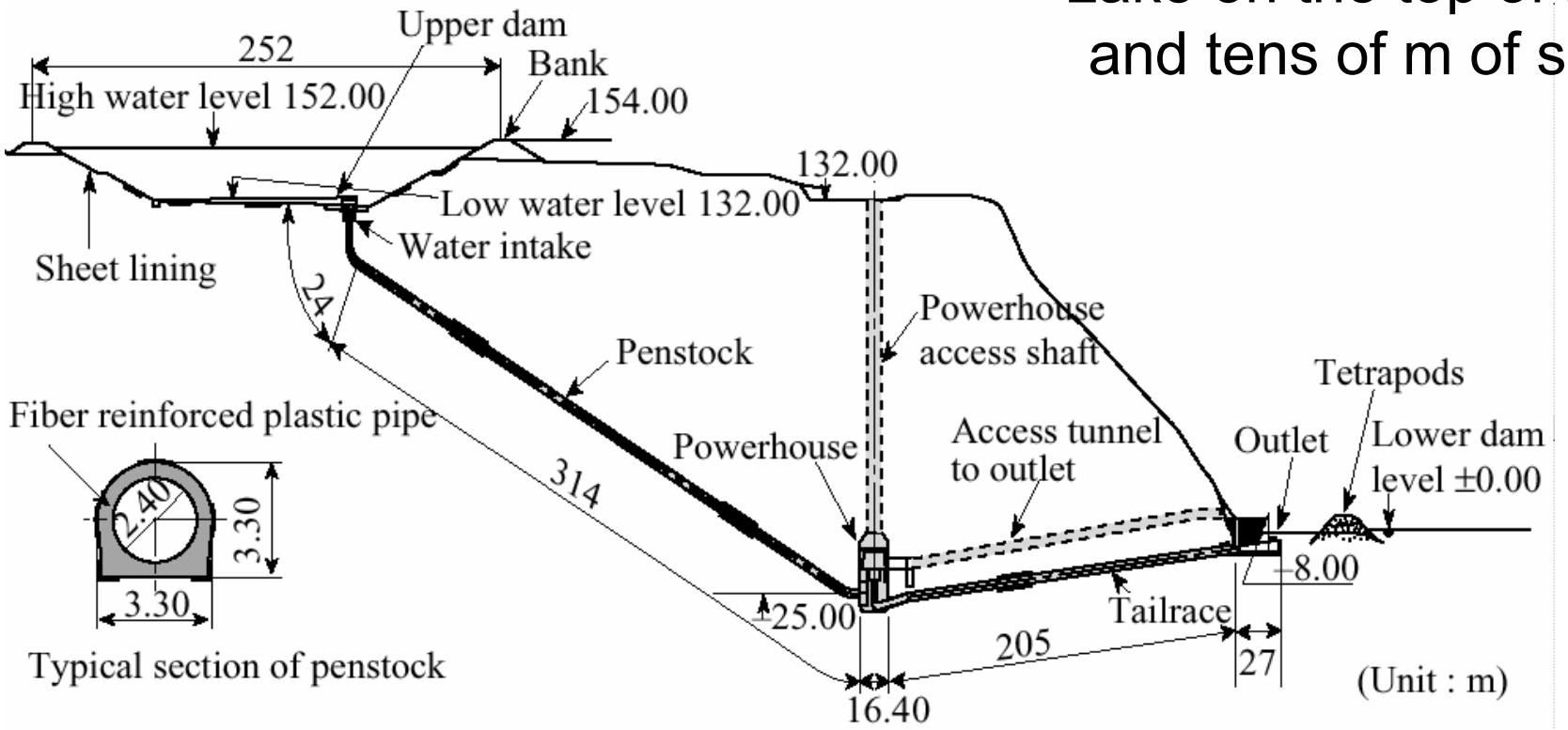
By Contrast, Pumped Storage (in future may be hydrogen)

- Can effectively absorb power from the grid
  - absorbing surplus output at night
- This is crucial for many generating mixes:
  - Nuclear plants can only change load slowly
  - Maintenance costs of some power stations increase sharply if they are forced to reduce load at night (Optimization important)
  - All other generators can be operated closer to their optimum efficiency
- Thus, pumped storage (hydrogen in future) leads to reduced emissions and improved overall system performance.

Ontario and Canada have many suitable locations

Rivers, lakes, seas-shores and a hill nearby

Lake on the top of a hill and tens of m of shore

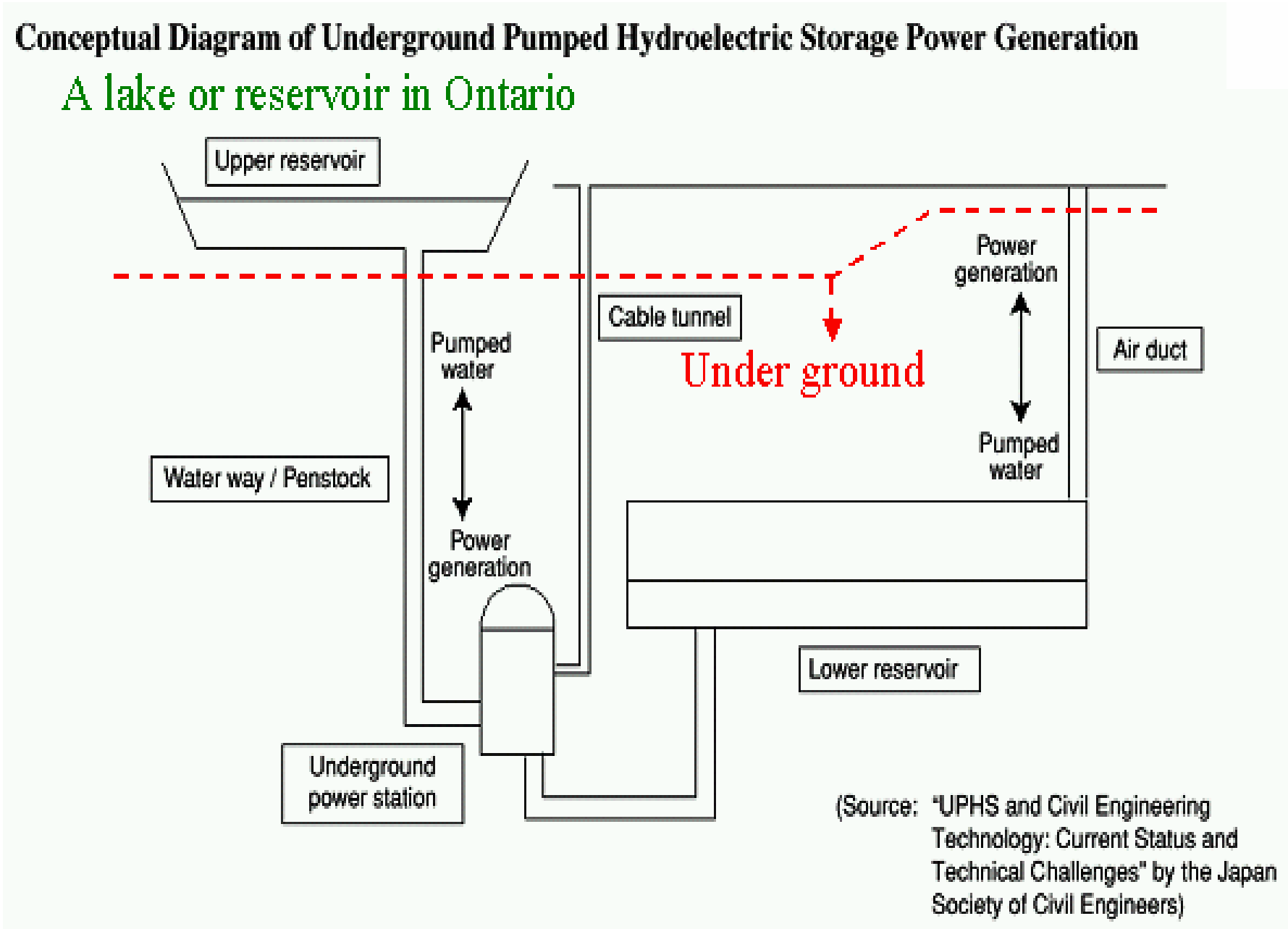


WANT TO SEE ME JUGGLE? I CAN KEEP A DOZEN EGGS IN THE AIR AT ONCE!
HUHH!
ACKPTH!
SPLOTCH
CRITCH
SPLAT
CRUNCH
CRAK
NOTICE I DIDN'T SAY I COULD DO IT VERY LONG.
THIS RUG MUST NEED A THICKER PAD.

Some hydro plants have a storage capability and can be utilized as a pumped hydro.

Underground pumped storage, using flooded mine shafts or other cavities, also feasible.

Conceptual Diagram of Underground Pumped Hydroelectric Storage Power Generation



Underground Pumped Storage Plant

Pumped hydro is available at almost any scale with discharge times ranging from several hours to a few days.

Overall efficiency: 70 – 85% range.

More than 100 GW of pumped storage in operation world wide (about 3% of global generation capacity).

Advantages

Top hill reservoir and underground pumped storage

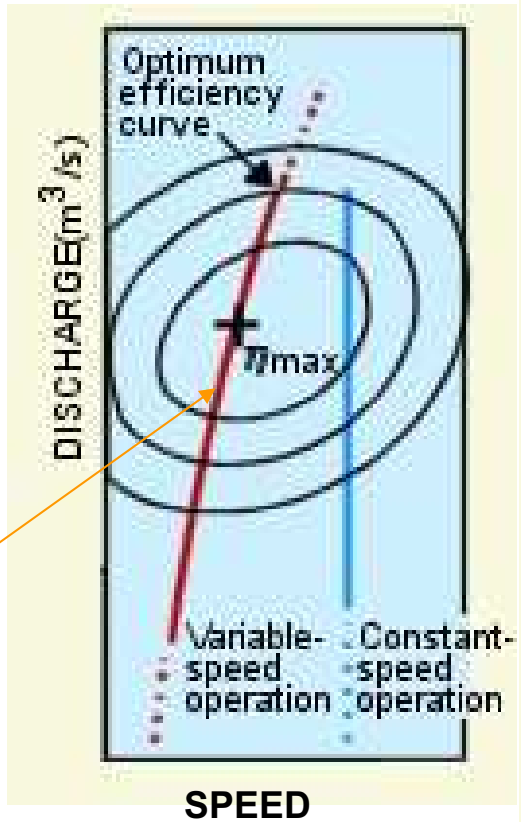
- Efficient use of land
- More freedom in site selection
  (more relaxed topographical requirements)
- Plants may sometimes be close to the demands
  thus reducing power transmission costs
- Reduced environment impact and
  preserving natural landscape

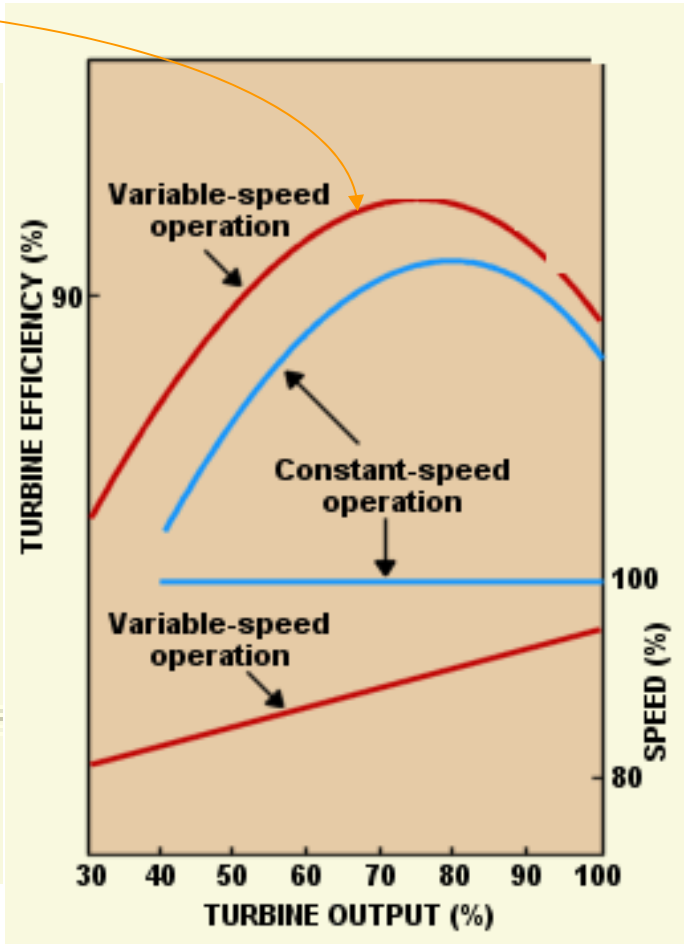
Adjustable speed Turbine (As of 1990) Wide Range Operation In Generating Mode

improved efficiency (10%)

and

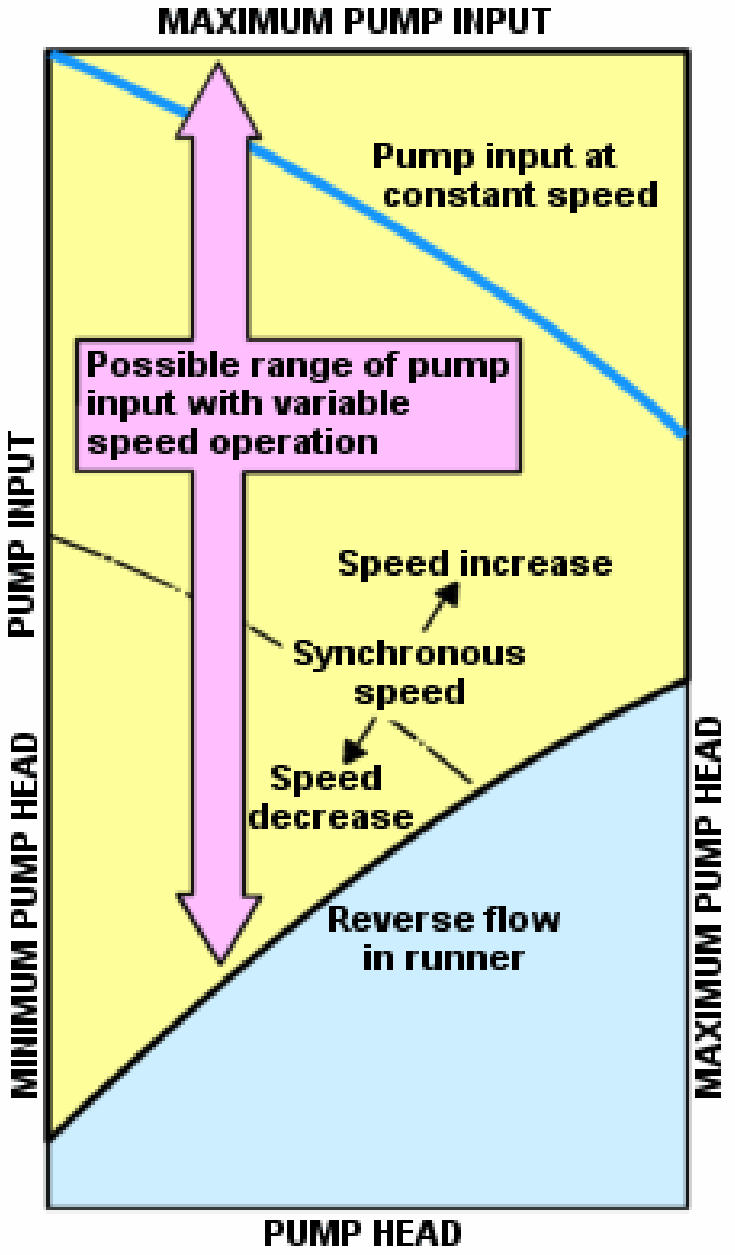
reduced vibrations





Adjustable speed pump

operation can vary in a specified range.



Adjustable Speed Pumped Storage Experiences

TOSHIBA has the richest experiences in the world.

CUSTOMER	POWER STATION	GENERATOR-MOTORS		SYSTEM OF SECONDARY EXCITATION	MANU-FACTURER	COMMISSIONING YEAR
		NUMBER OF UNITS	UNIT CAPACITY (MVA)			
Tokyo Electric Po. Co.	YAGISAWA	1	85	CYCLOCONVERTER	TOSHIBA	1990
Hokkaido Electric Po. Co.	TAKAMI	1	140	GTO INVERTER	MITSUBISHI	1993
Kansai Electric Po. Co.	OKAWACHI	2	395	CYCLOCONVERTER	HITACHI	1993 - 1995
Tokyo Electric Po. Co.	SHIOBARA	1	360	CYCLOCONVERTER	TOSHIBA	1995
Electric Po. Development Co.	OKUKIYOTSU No.2	1	345	GTO INVERTER	TOSHIBA	1996
Electric Po. Development Co.	OKINAWA YANBARU	1	31.5	GTO INVERTER	TOSHIBA	1999
Hokkaido Electric Po. Co.	KYOGOKU	1	228	GTO INVERTER	TOSHIBA	2006
Tokyo Electric Po. Co.	KAZUNOGAWA	2	475	GTO INVERTER	TOSHIBA	2009
Kyushu Electric Po. Co.	OMARUGAWA	1 / 1	350 / 370	GCT INVERTER CYCLOCONVERTER	MITSUBISHI / HITACHI	2008 / 2008

1000 MW and Larger Pumped Hydro Installations Worldwide

Please send missing information to anourai@electricitystorage.org

Location	Plant Name	On-Line Date	Hydraulic Head (m)	Max Total Rating (MW)	Hours of Discharge	Plant Cost
Australia	Tumut 3	1973		1690		
China	Tianhuangping	2001	590	1800		$1080 M
	Guangzhu	2000	554	2400		
France	Grand Maison	1987	955	1800		
Germany	Markersbach	1981		1050		
	Goldisthal	2002		1060		$ 700 M
Iran						
Italy						
Japan						
Luxe						
Russ						
South						
Taiw						
U.K./						
USA						
USA						
USA						
USA						
USA / NY	Blenheim-Gilboa					
USA / NY	Lewiston (Niagara)	1961	33	2880	20	
USA / SC	Bad Creek	1991	370	1065	24	$ 652 M
USA / TN	Racoon Mt	1979	310	1900	21	$ 288 M
USA / VA	Bath County	1985	380	2700	11	$1650 M

600 $/kW

/kW

587 $/kW

Goldistahl, Germany

Variable speed

international state-of-the-art

Efficiency increased 10% +

Maintenance cost reduced 50% +

Investments 660 $/kW

From the Internet …

Link:http://www.vattenfall.com/files/responsibilities/CSR_2003_5.PDF

Commissioning of the German Goldistahl pumped storage power plant.

- The importance of pump power stations is increasing given the growing number of wind power and solar power plants.
- Goldisthal is Germany's largest pumped storage plant and was opened September **2003** after more than six years of construction and investments of EUR 620 million.

Good News

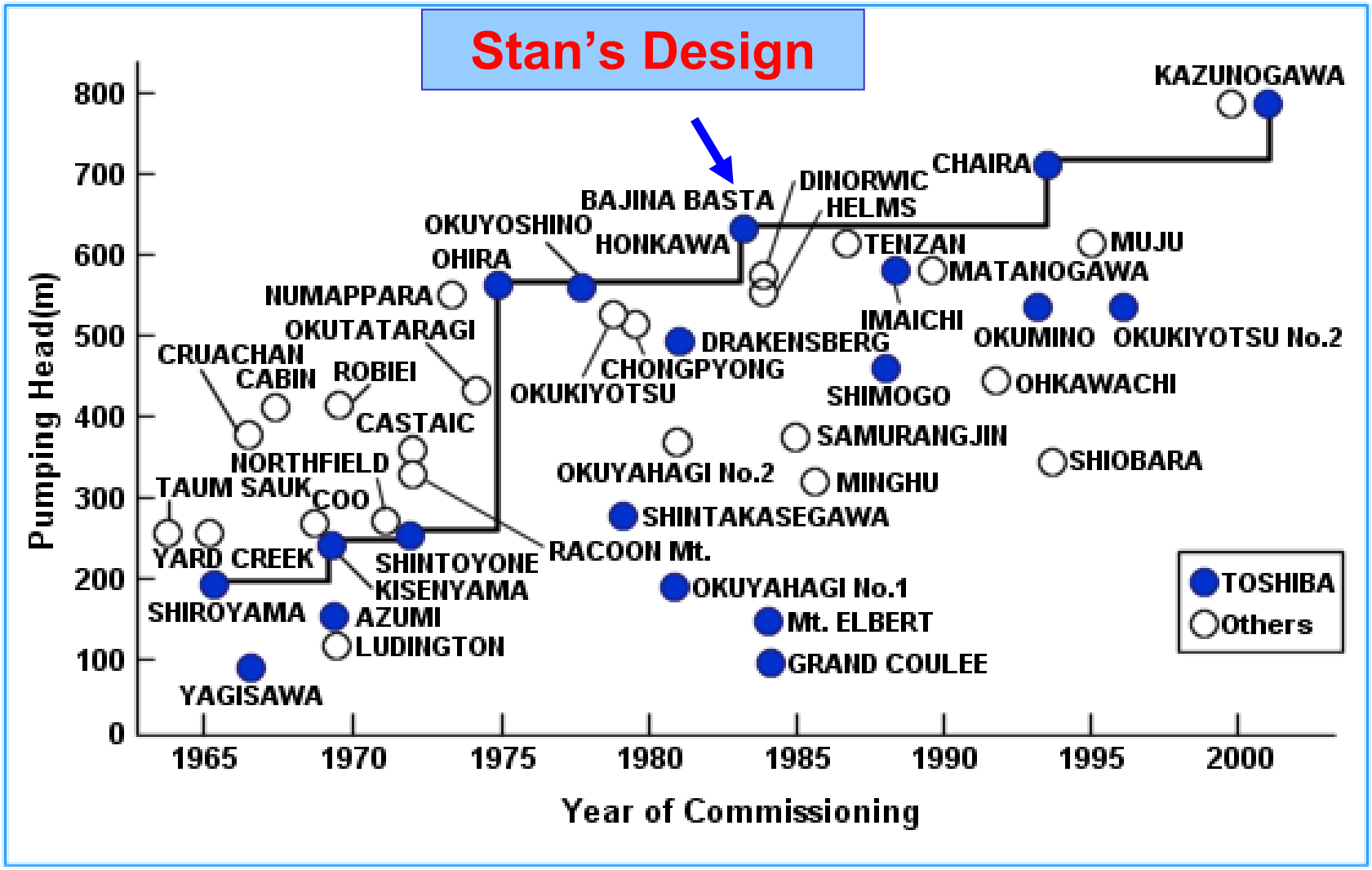
- Globe and Mail (Nov. 2004): “The Ontario government is opening Crown land for development by power companies to harness the potential of the province's untapped rivers for **hydroelectric projects.”**

The Ontario Ministry of Energy has put these on the table.

Next step: Pumped-Storage Plants.

This is essential and a key priority!

Single Stage Pump-Turbine heads:
Flexibility! 30 to 782 m



Sir Adam Beck No. 3

Pumping-Generating Station **(1958)**

-utilizes water stored from Niagara River during low electricity demand periods to generate additional 174 MW of electricity when electricity demand is highest.

--Direct EXPERIENCE Gap

of 48 years

Beck 3 (under construction)

- New 10.5 km underground tunnel from above Niagara Falls to new 900 MW underground generation station near the existing Sir Adam Beck.

- First proposed by Ontario Hydro in 1991; received environmental approval in 1998.
- Government intends to work with the private sector.

NEWS RELEASE

September 14, 2005

- Government is adding more clean, renewable power to Ontario's electricity by boosting the Sir Adam Beck Generating Complex
- Niagara Tunnel project will generate 1.6 billion kilowatt hours of clean, reliable power in 2009.
- Water would be pumped during the night-time period when the requirement for a scenic flow over the Falls is reduced to a minimum of 1416 cubic metres per second (50,000 cubic feet per second).

- More than 3 years we have been promoting pumped storage. We would like to share this success with you.
- Stan is the most experienced and knowledgeable in Ontario, may be in Canada as well!

- Of 9,000 megawatts of new supply
- 23% is nuclear,
- 23% cent is renewable,
- 56% gas, wood-waste, or other fuels.

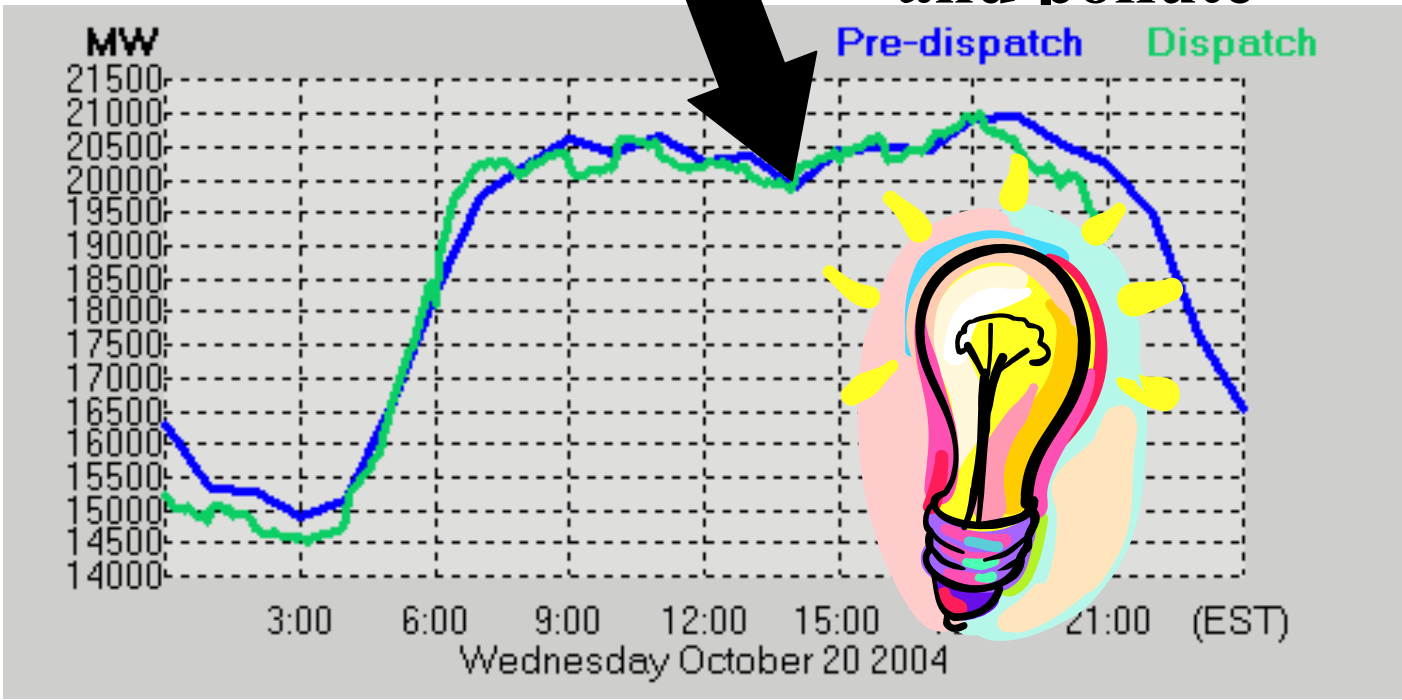
- We give full credit for re-opening the nuclear option for Ontario
- Combining with pumped-storage plants reduced nuclear for 50%

Coal and nuclear

100% generation

100% pollution

Peak hours both units generate and pollute



50% generation

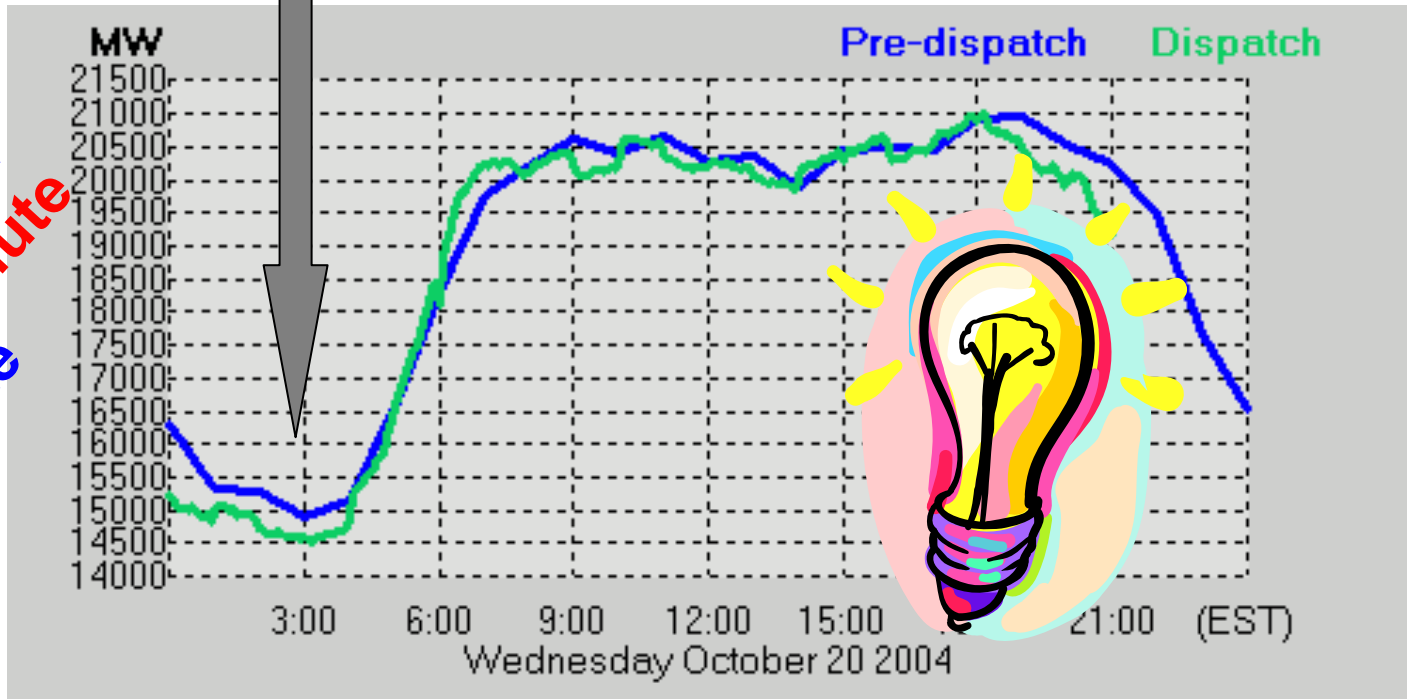
very expensive

Coal and nuclear

100% pollution

Nuclear and coal plants cannot stop

Low consumption
both plants pollute
50% generate



Coal and nuclear

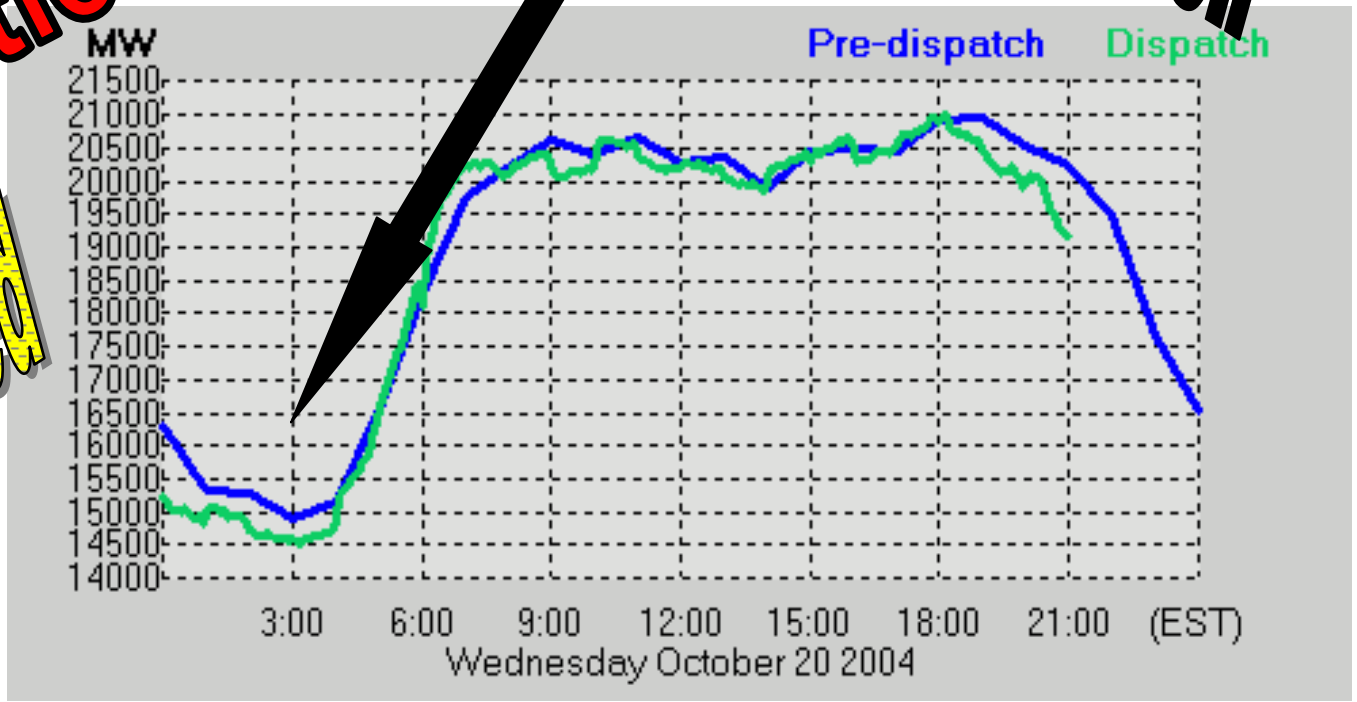
50% storage

50% generation

One pump storage and and
one thermal or nuclear

50% pollution

Surplus pumped



100% generation

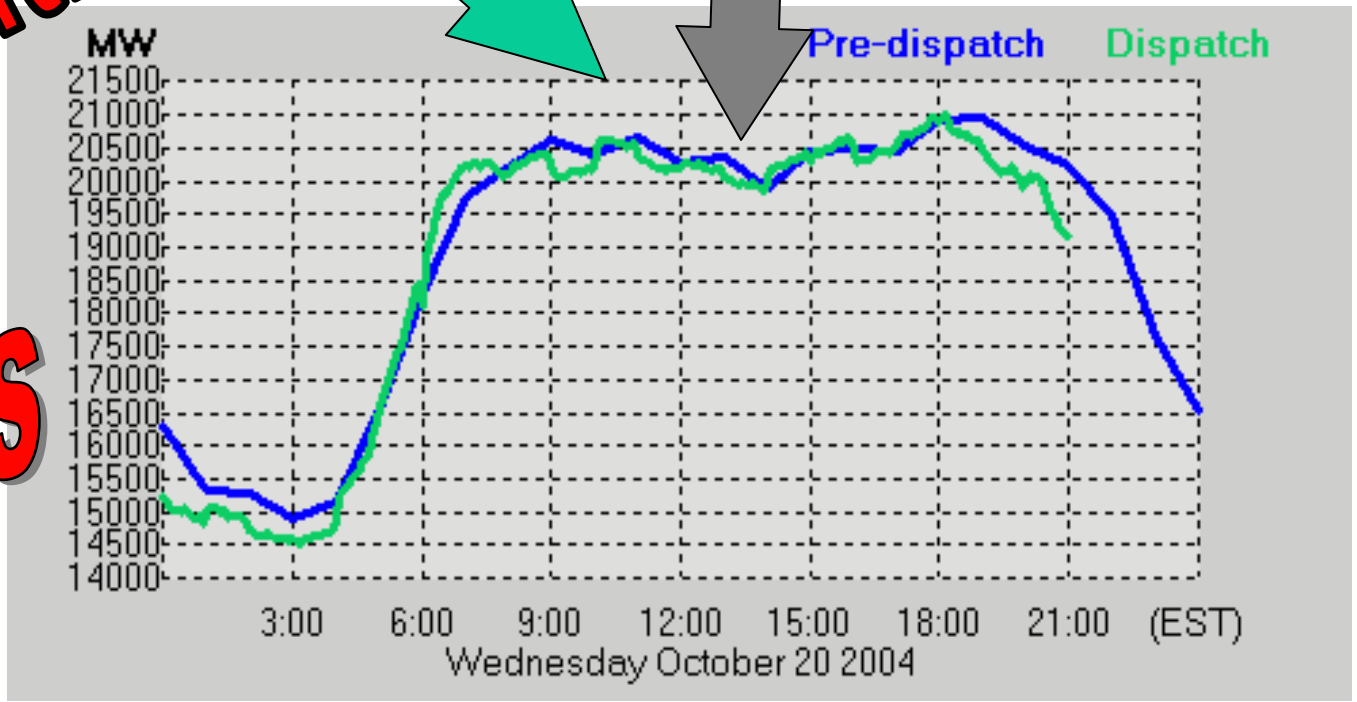
Coal and nuclear

Peak hours generation

Peak hours both units generate 50% pollution

50% pollution

low costs



"D'you believe this! It said, 'Umbrellas 50% Off.'"

Hydro Electric

- Significant untapped potential in Ontario
- Clean and renewable energy
- Low price per kWh
- Drought can endanger reliable supply of electricity

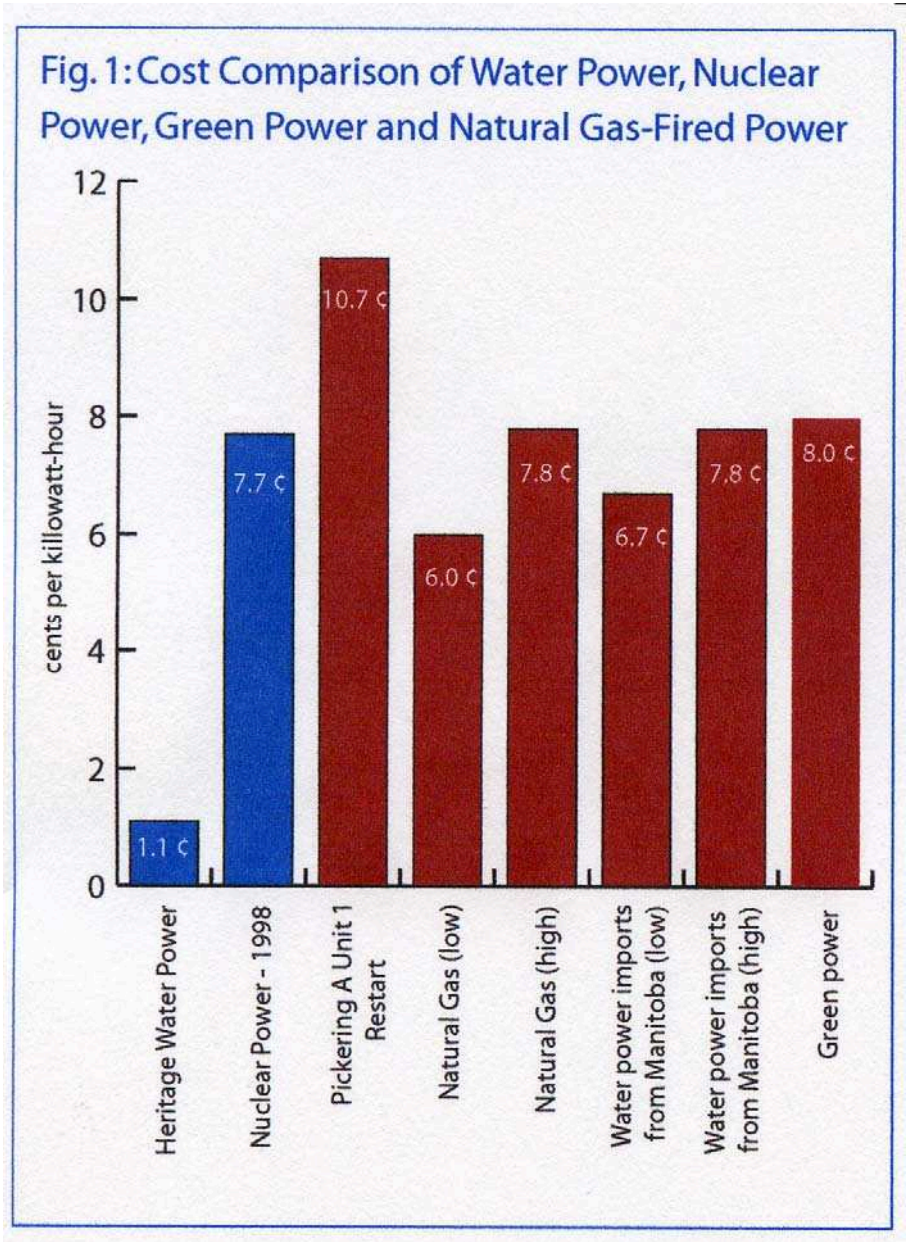
Investments US$/kW

- CANDU 6 US$1500 per kW
- ACR US$1100 per kW
- Hydroelectric plants US$ 600 per kW +

Combination with pumped storage plants can reduce investments and maintenance costs

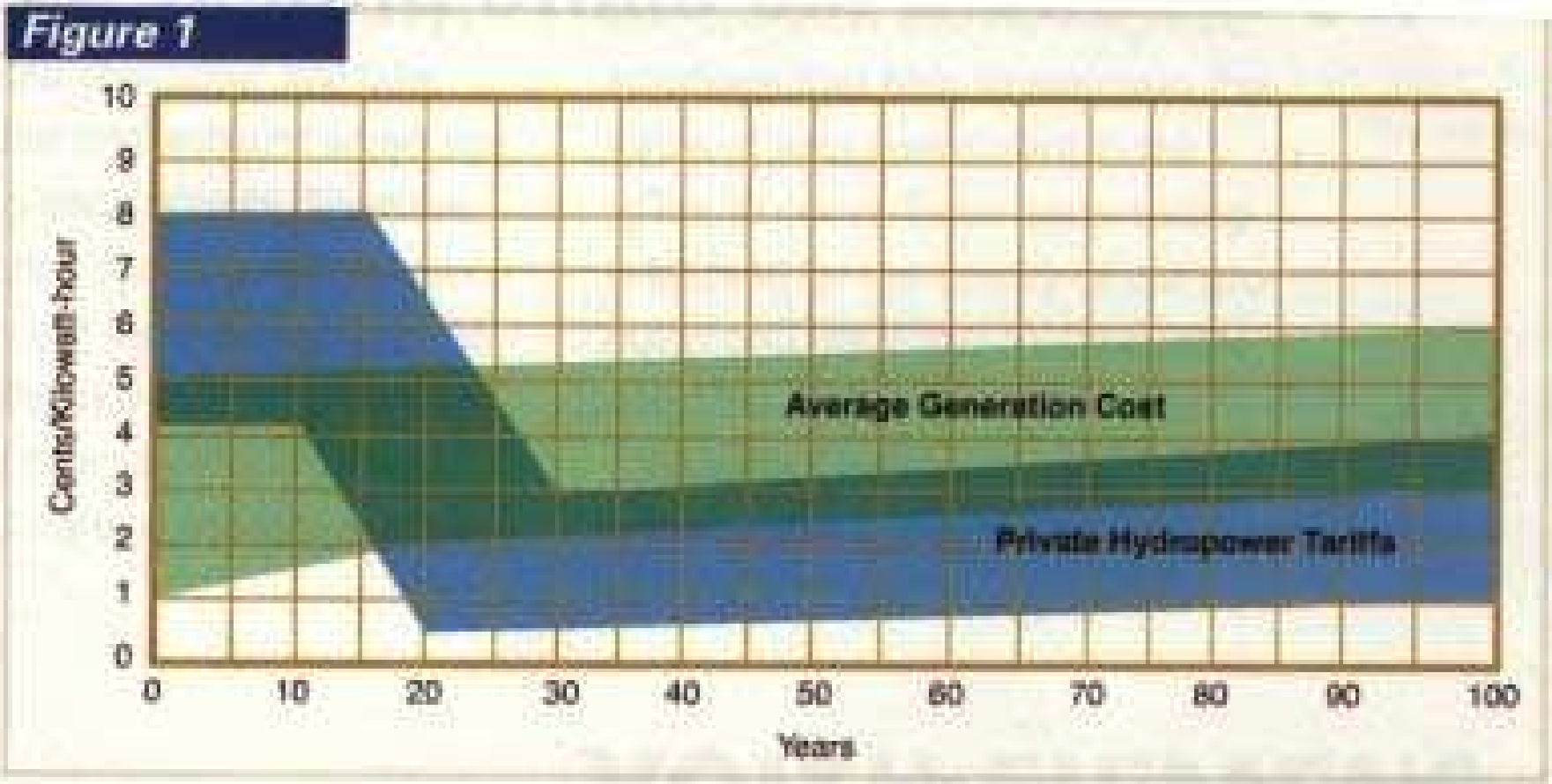
and

increase efficiency of the grid



From OCAA "Energy Facts"

Low price per kWh



High tariffs in the first ten to 20 years of operation can deter private investment in hydropower.

Reversible Pump-Turbine Storage Power Plants

(hydrogen as well)

- Solution to Peak Power Generation
- Solution for “spinning no load” reserve
- Solution for stand-by reserve
- Clean and renewable energy
- Low price per kWh
- Droughts do **not** endanger electrical supply
- But, lack of Canadian know-how?

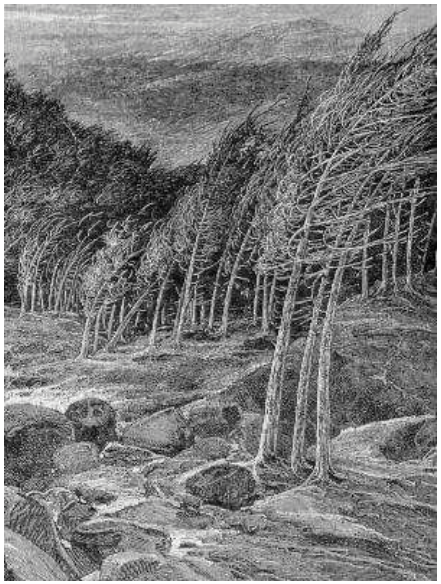
Renewables

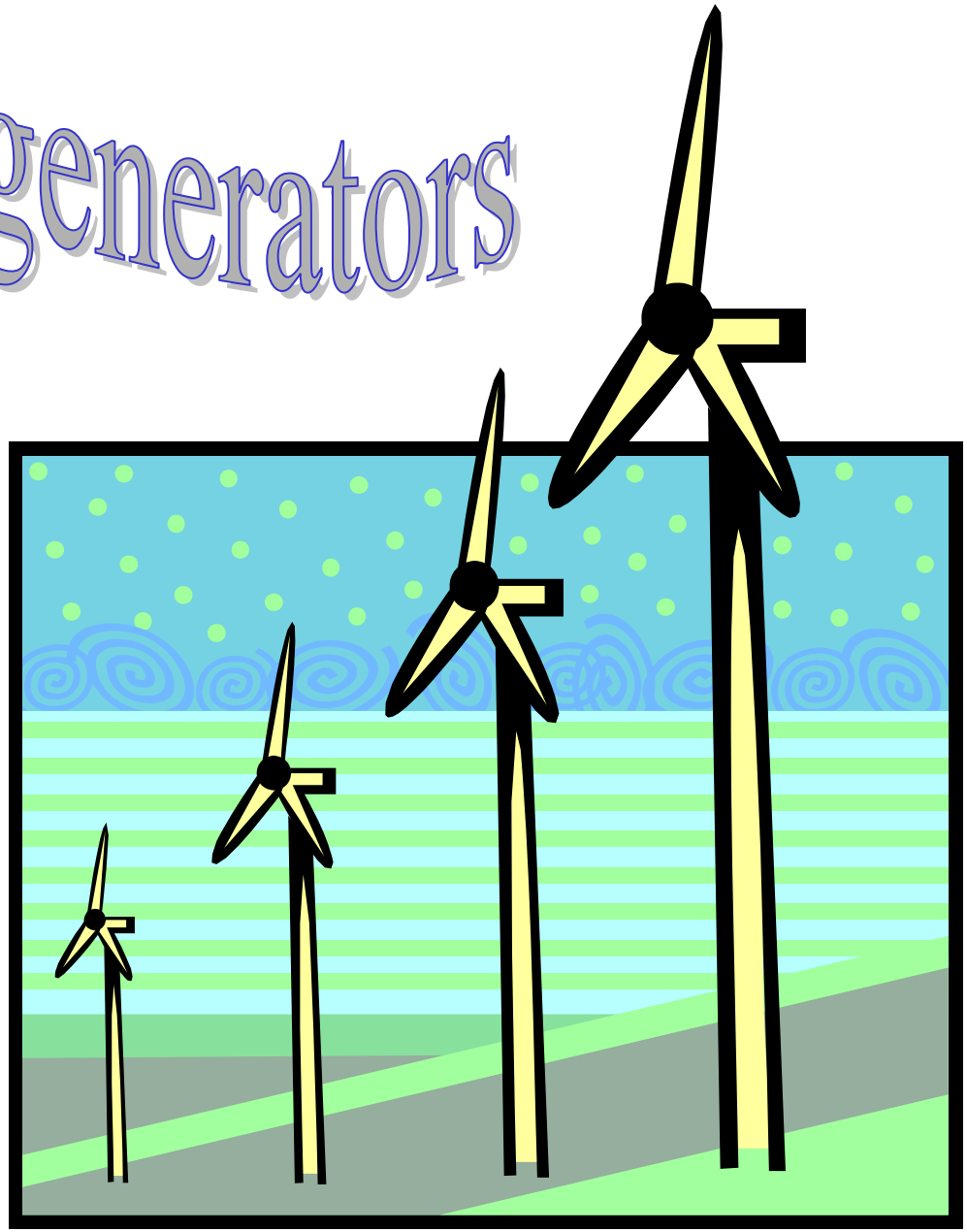
- Solar Biomass Wind

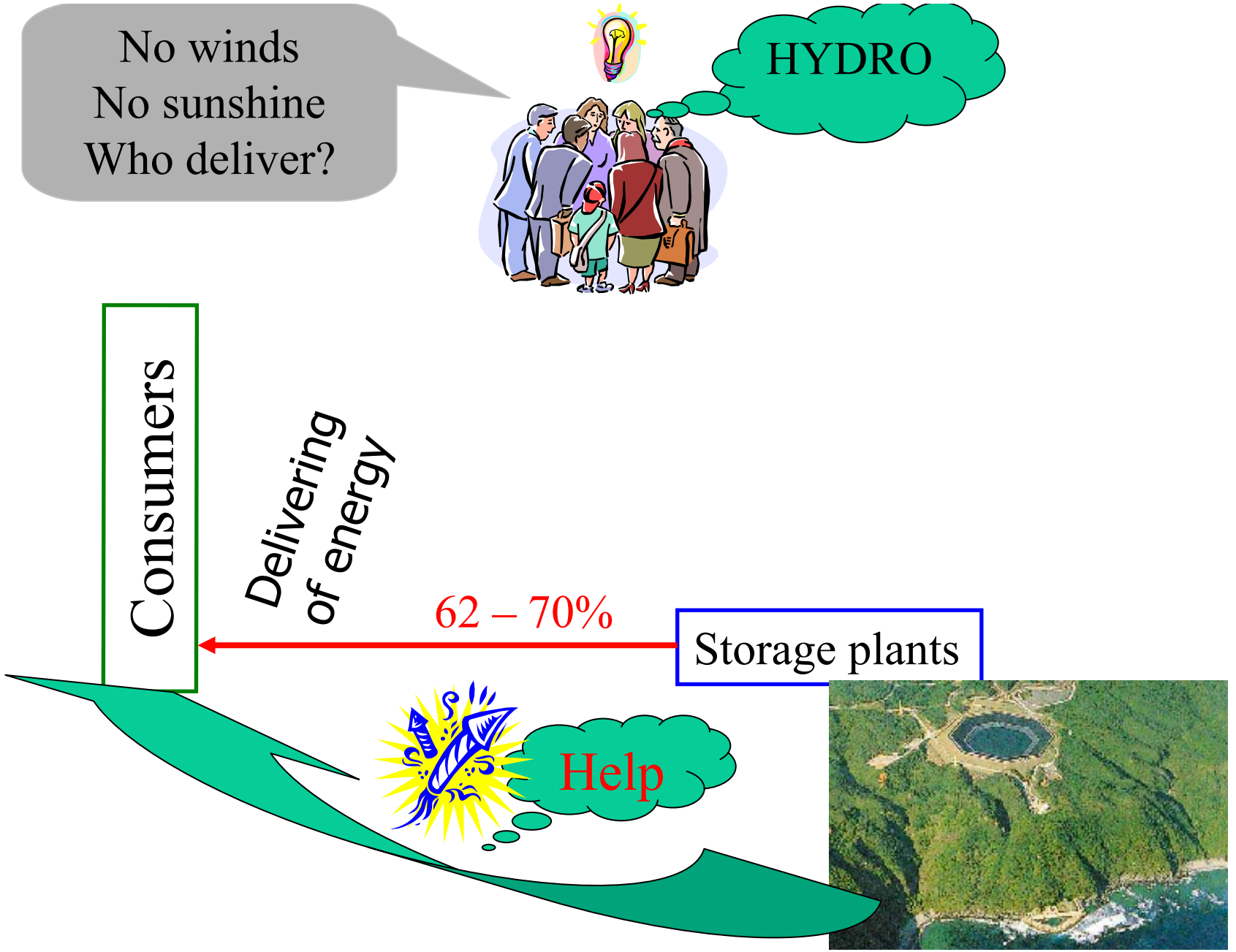
- **Utilising solar or wind in a grid requires duplication of generating capacity due to their intermittent nature** OR storage!
- All require significant embedded energy investments to construct.

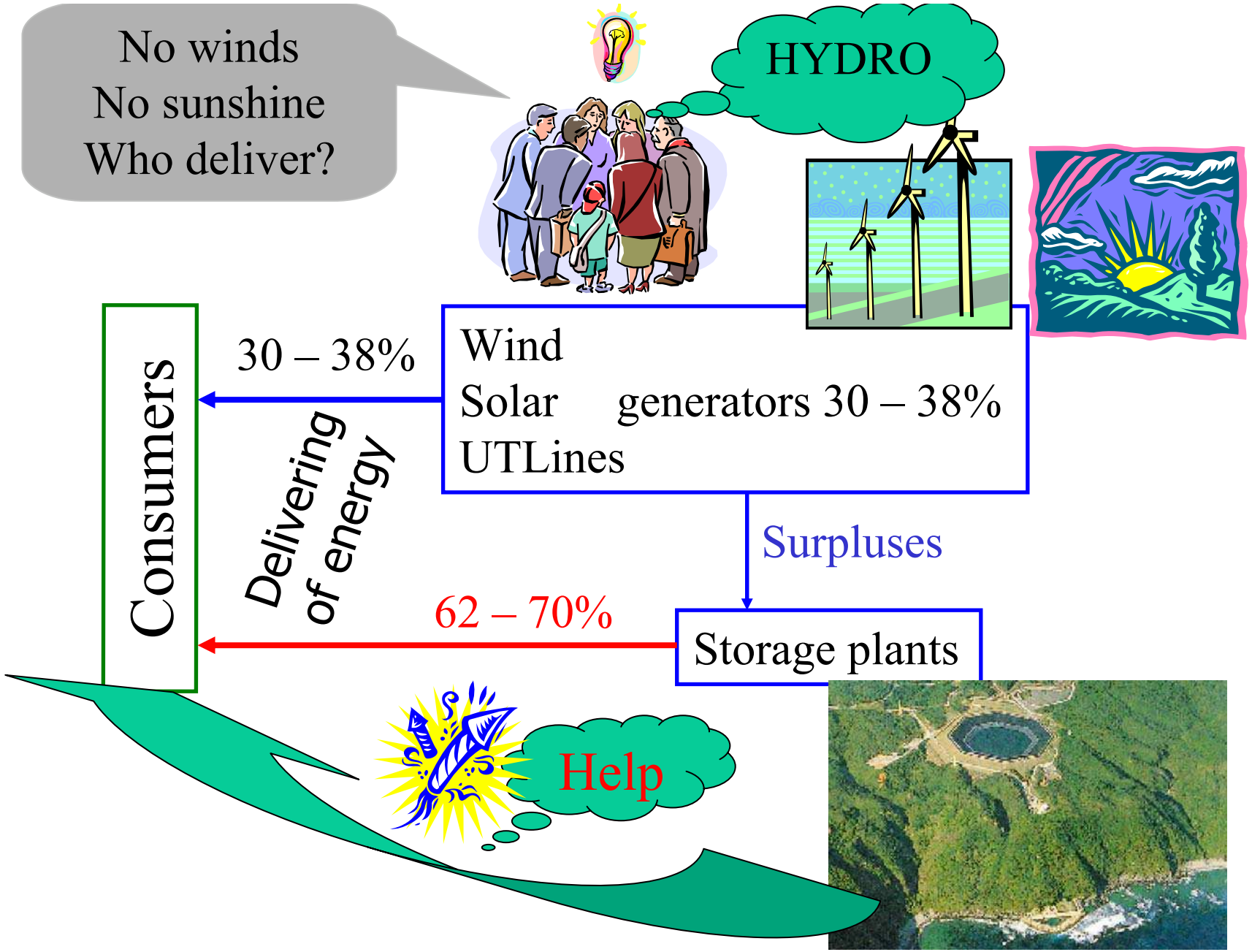
Impact on the overall power generation requirements for Ontario is likely small, but magnified with storage.

Wind generators






No winds
No sunshine
Who deliver?
HYDRO
Consumers
Delivering of energy
62 – 70%
Storage plants
Help


No winds
No sunshine
Who deliver?
HYDRO
Consumers
30 – 38%
Delivering of energy
Wind
Solar generators 30 – 38%
UTLines
Surpluses
62 – 70%
Storage plants
Help

Germany & Denmark

- Essentially what happens with Denmark: wind capacity is complemented by link and storage in Norway and Sweden.

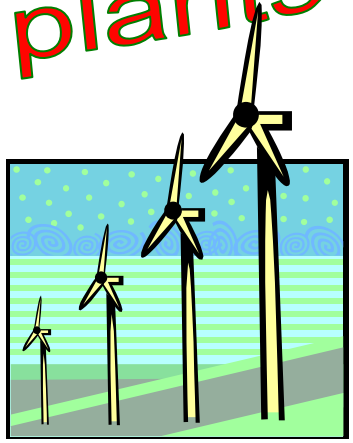
Don't compare Ontario and Germany

Nor Canada and Denmark

Storage is key!

Canada must build such plants.

Then



Uncertain Planning 1

- A year ago Government fixed price **4.3 cents per 1 kWh for several years**
- Les than a year later price cap has been **raised to 4.7 cents** per kilowatt-hour for the first 750 kilowatt-hours used per month, and to **5.5 cents** after that level
- **What happens next?**

- **Price changes have HUGE implications?**

Planning Challenges 2

- The government promise to close five coal plants by 2007
- New government changes mind….

1. Such changes are expensive and
2. Well thought out replacement very difficult to build in 3 years!

ONTARIO POWER AUTHORITY

- **Term of office and reappointment**

- A director appointed shall hold office until unable to work or retirement
- In other words, a system analogous to tenure

- Reason:
- To be independent of politics and parties
- Decisions to be the best technical solutions

Hidden Challenge

There is another challenge behind Bill 100 …

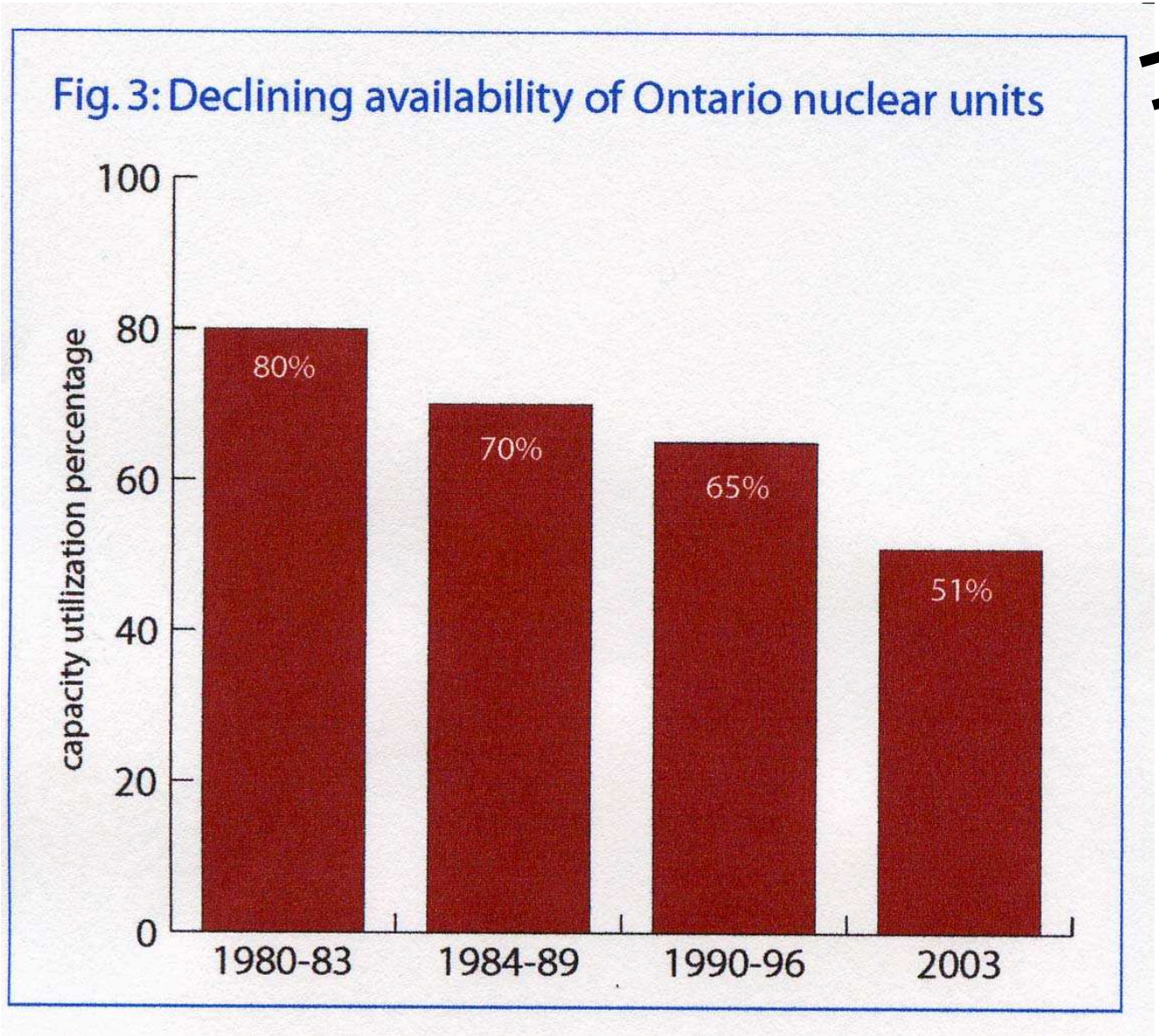
- If not addressed, legislation will not reach its excellent goals
  - stable power delivery (without failure) and
  - stable power prices
- Requirement: The power system must be
  - **Well designed -** that is, there must be a **reserve capacity** of power production
- Only then can the system be stable and blackouts avoided

Know-How

- Multidisciplinary Transfer of Experience and Knowledge

  continuity has been lost.

- Canada has had more than 100 years of experience, but individual areas have lost accrued experience and knowledge.
- Is nuclear performance related to this?



From OCAA "Energy Facts"

ONTARIO POWER GENERATION

Ontario Supply Mix

Presentation to the Ontario Power Authority

Pierre Charlebois, Chief Nuclear Officer
Bruce Boland – SVP, Corporate Affairs
Pat McNeil – SVP, Nuclear Strategy and Support

September 26, 2005

Presentation Outline

1. Key Factors for Consideration in Arriving at Supply Mix

2. Supply Mix Issues and Concerns

3. Nuclear Issues

4. Hydroelectric Issues

Key Factors for Consideration

OPG notes that the OPA's approach to long-term resource planning "will develop and evaluate different portfolios of supply sources and conservation options", which will then be "evaluated against certain criteria". OPG supports this approach, and would like to propose certain criteria for inclusion within the portfolio evaluation.

- Safety, Reliability and Adequacy of Supply
- Diversity of Fuel Mix
- Economic Costs
- Geographic / Power System Location
- Technological Attributes / Limitations / Risks
- Environmental Compliance and other Regulatory Requirements
- Social Considerations
- Product being Supplied

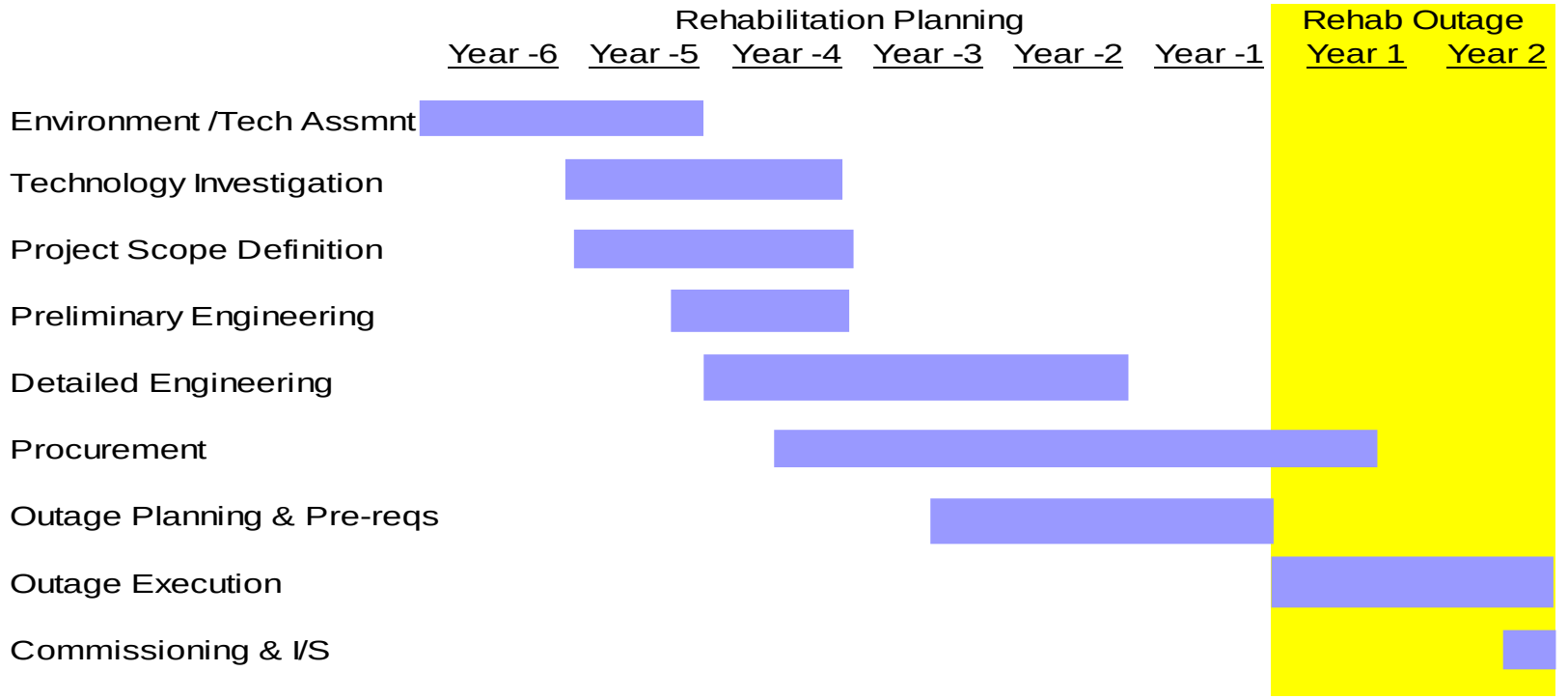
Supply Mix Issues and Concerns

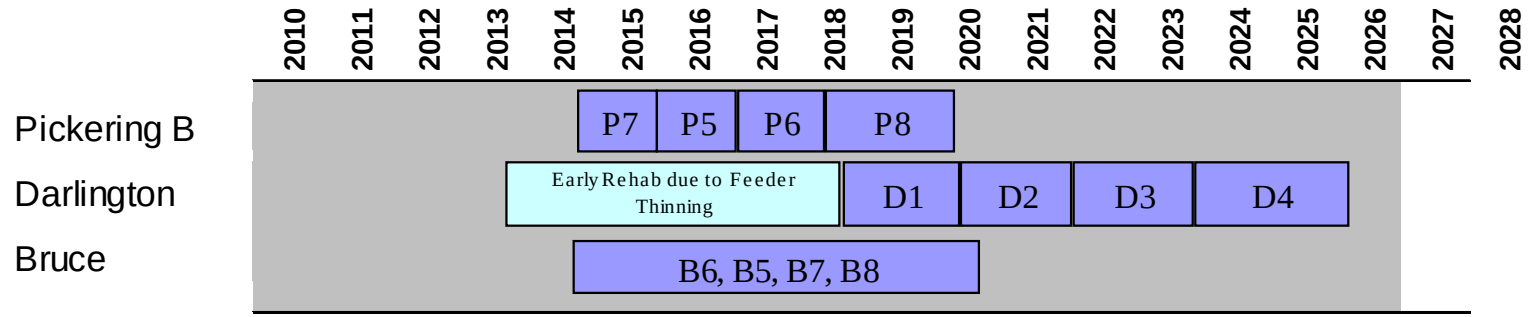
Different technologies exhibit different attributes that make them particularly suited to fulfilling baseload, intermediate or peaking roles within a power system. Each of these roles is critical in ensuring reliability of supply and operational stability.

- Dispatchability
- Ramp Rates
- Operational Efficiency
- Minimum Output
- Size
- Gas Infrastructure Issues
- Locational Issues

Planning Considerations - Nuclear Refurbishment

Note: This information is illustrative only.





Considerations – Nuclear New Build

Technology Considerations:

- Reactor Output:
  - Optimum size for Ontario
  - Spinning reserve requirement
- Technology Issues (if different from existing CANDU)
  - Additional parts
  - Different licensing basis and design authority
  - Different training programs and facilities
  - Heavy water for CANDUs (depending on # of reactors)
  - Enriched fuel issues
  - Differences with respect to security

Commercial Considerations:

- Financing:
  - Power Purchase Agreement
  - Joint Ventures
- Risk assumption with reactor vendor
- Commercial Issues (if different from existing CANDU)
  - Training costs
  - Lack of transferability of staff between designs
  - Compliance costs of two technologies

Regulatory Considerations:

- CNSC Licensing
- Environmental Assessments
- Light water exclusion zones
- OEB considerations such as the need for a “Leave to Construct” arrangement

New Nuclear Capital Cost Estimates

Capital Cost Estimates for New Build

	ACR-700[1] (1st pair)		CANDU 6[1]		ABWR[2]		AP1000[2,3]		EPR[4]	
	$/kW	% of Toal	$/kW	% of Toal	$/kW	% of Toal	$/kW	% of Toal	$/kW	% of Toal
Equipment & Material	993	41%	1,160	38%	906	51%			1,681	83%
Construction & Module Fabrication	758	31%	1,037	34%	531	30%				
Engineering, Project and Commissioning Management	368	15%	384	13%	235	13%			217	11%
Heavy Water and Fuel	88	4%	261	9%						
Plant Cost	2,207	91%	2,843	93%	1,672	95%	2,325	94%	1,899	94%
Owner's Cost	221	9%	231	8%	90	5%	156	6%	117	6%
Total Price, incl. Owner's Cost	2,428	100%	3,074	100%	1,762	100%	2,482	100%	2,015	100%

Source

1 AECL, *Planning for New CANDU Reactors* , presention to OPG, November 5, 2004

2 Univ. of Chicago, *The Economic Future of Nuclear Power* , August 2004

3 US DOE (EIA), *Assumptions to 2005 Annual Energy Outlook* , April 2005

4 Didier Beutier (AREVA), *EPR Background and its Role in Continental Europe* , June 23, 2005

Note: OPG estimates of LUECs (based on vendor data) are in the $ 50 to $ 65/ MWh range, assuming WACC = 7%

Potential Hydroelectric Plans

Expansions and potential for new build.

- Runner Upgrade Program (including conversion of Beck 25 Hz units):
  - Incremental capacity and energy of approximately 150 MW and 0.5 TWh, respectively.
- Niagara Tunnel – 1.6 TWh of energy
- Expansions:
  - 20 to 25 reasonably economic opportunities totalling up to 600 MW that could be pursued in the short to medium term, the largest being a potential expansion of the Lower Mattagami River plants.
- Greenfield Site Evaluations:
  - Moose River Basin (approximately 900 MW)
  - Little Jackfish (132 MW)

Waterpower in Ontario

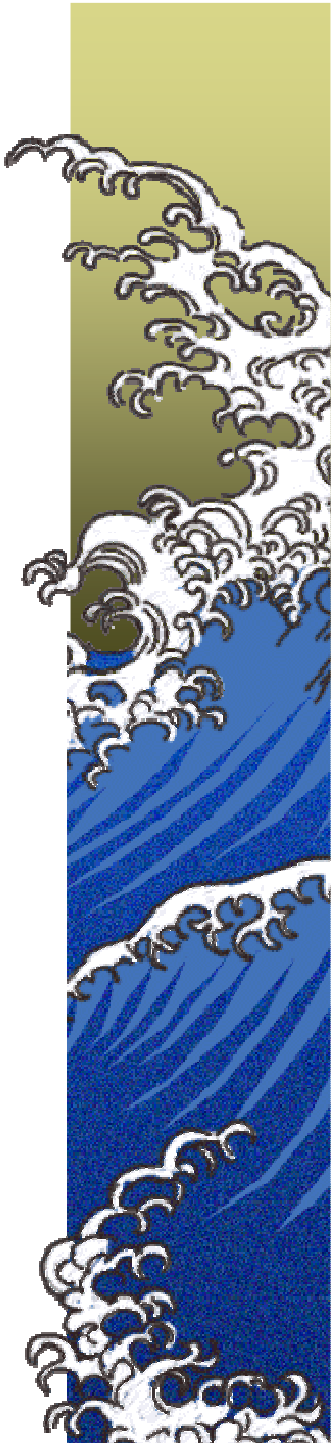
Challenge the assumptions

Ontario Power Authority

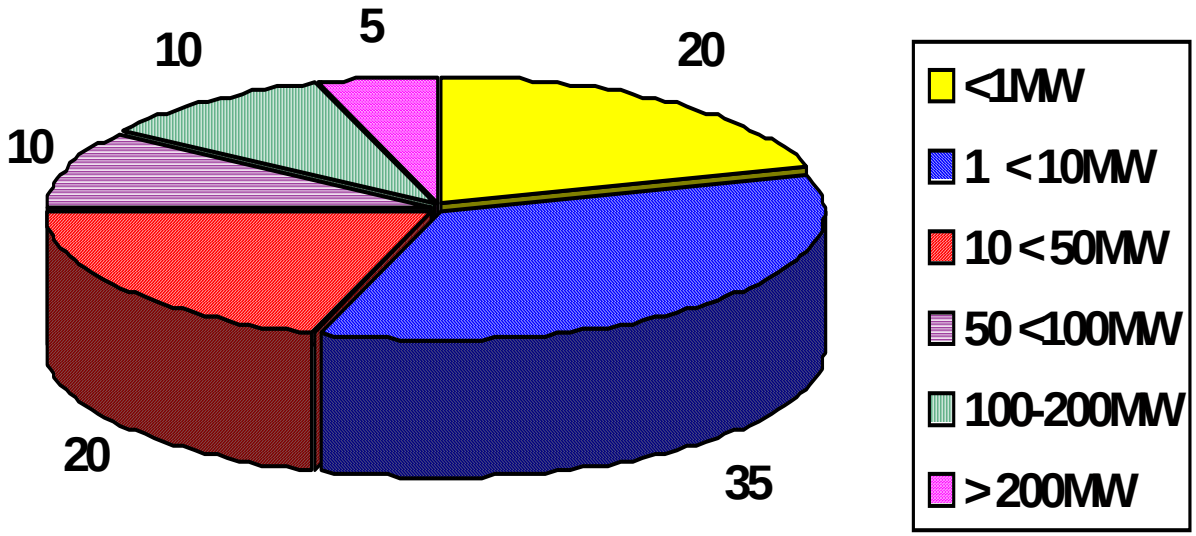
October 11, 2005

Ontario Waterpower Association

- Founded in May 2001 (8 founding members)
- Currently 90 members and growing
- >95% generators, generation
- Engineering, legal, environmental firms
- Strategic alliances with other organizations
- Responsible advocacy



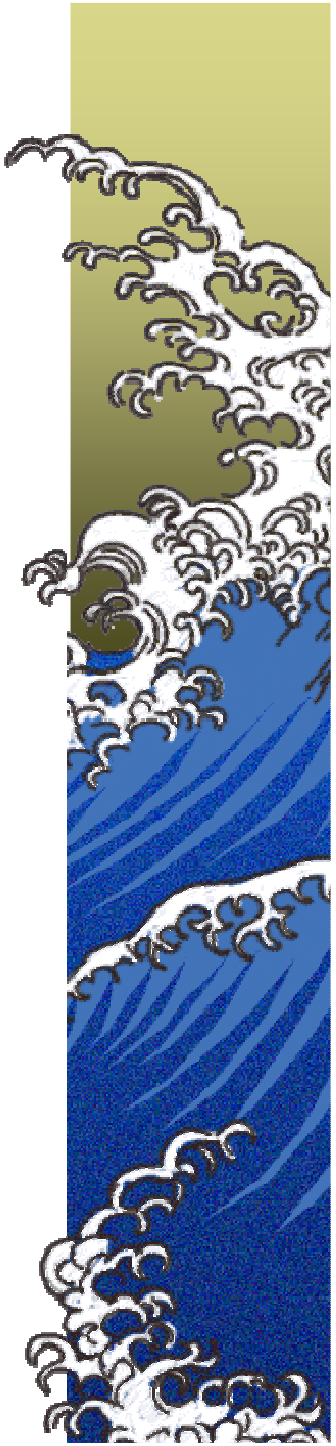
A Diverse Portfolio



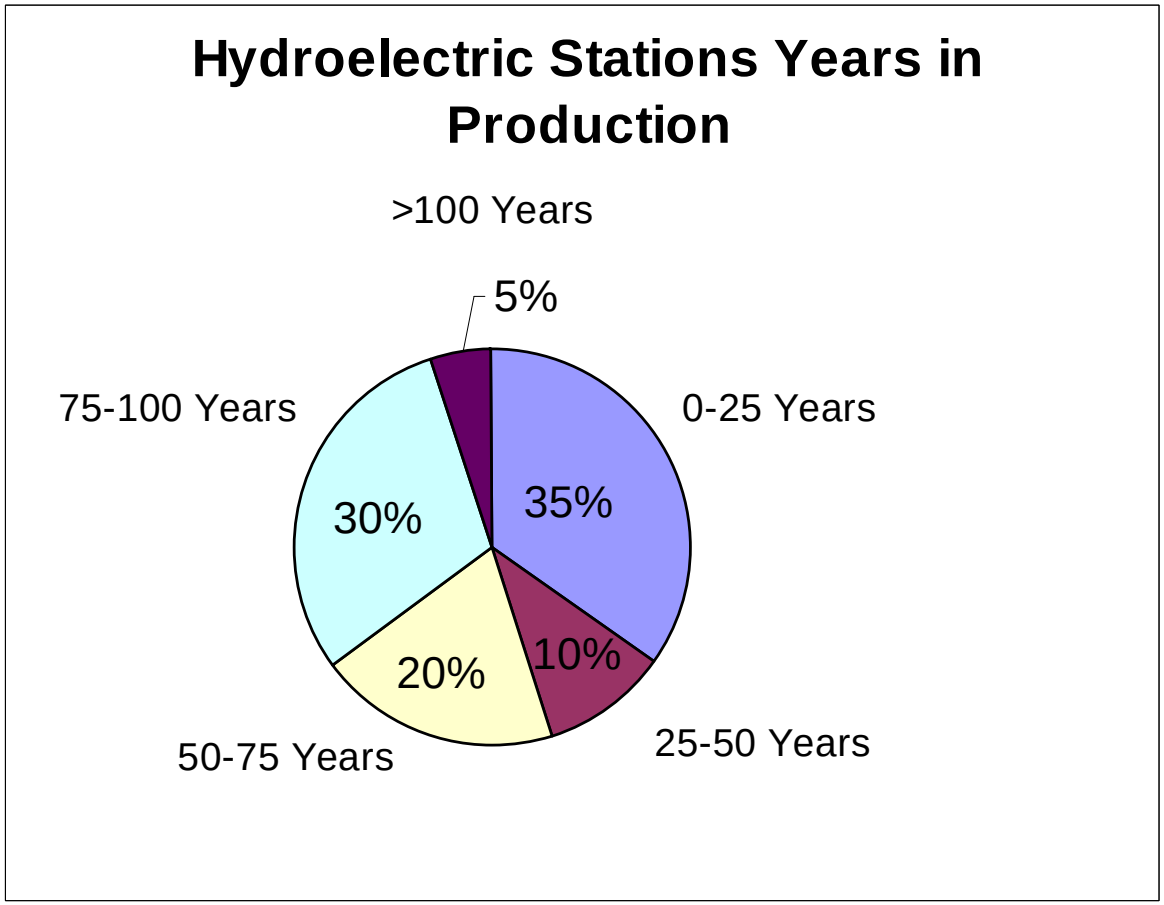
Relative % by facility capacity

Serving multiple needs

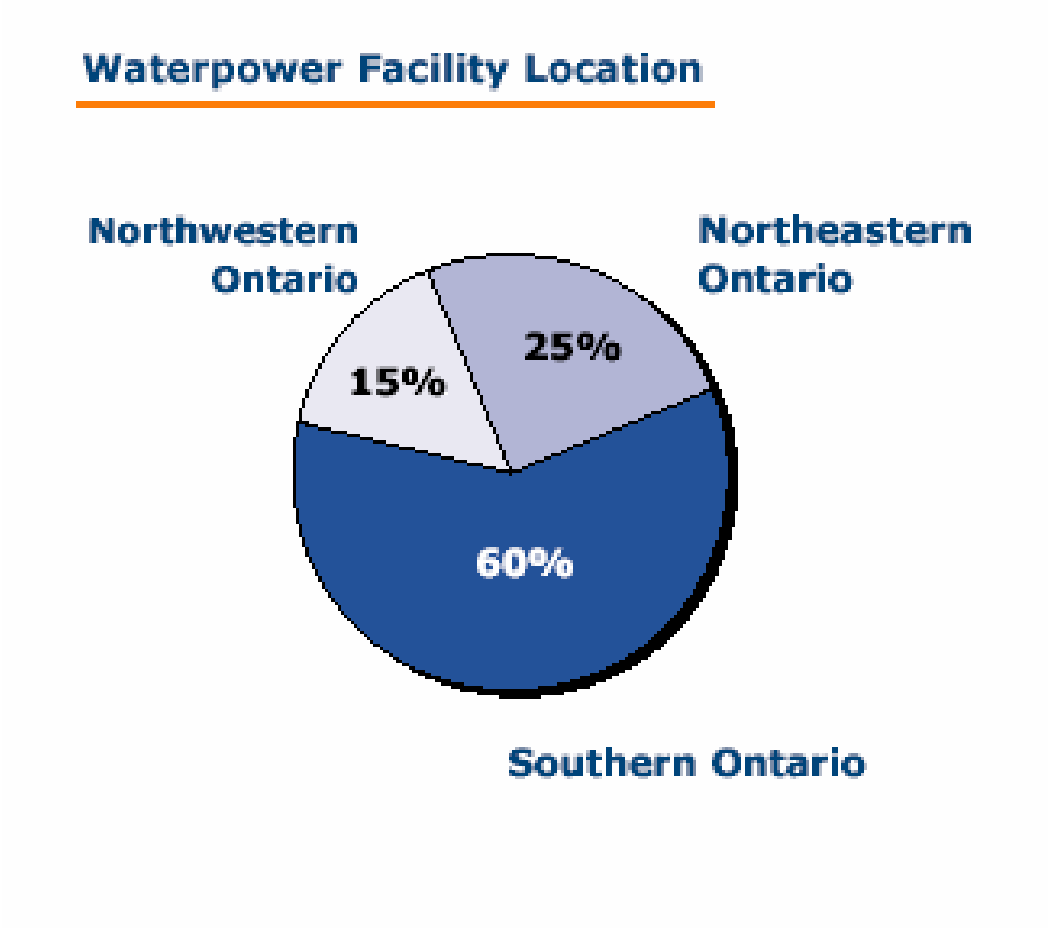
- 190 Operating Facilities (> 500 “pre-coal”)
- 65 Owned by OPG Municipals
- Industrials
- “Large” Private Sector
- “Small” Private Sector
- Individual Entrepreneurs
- First Nations



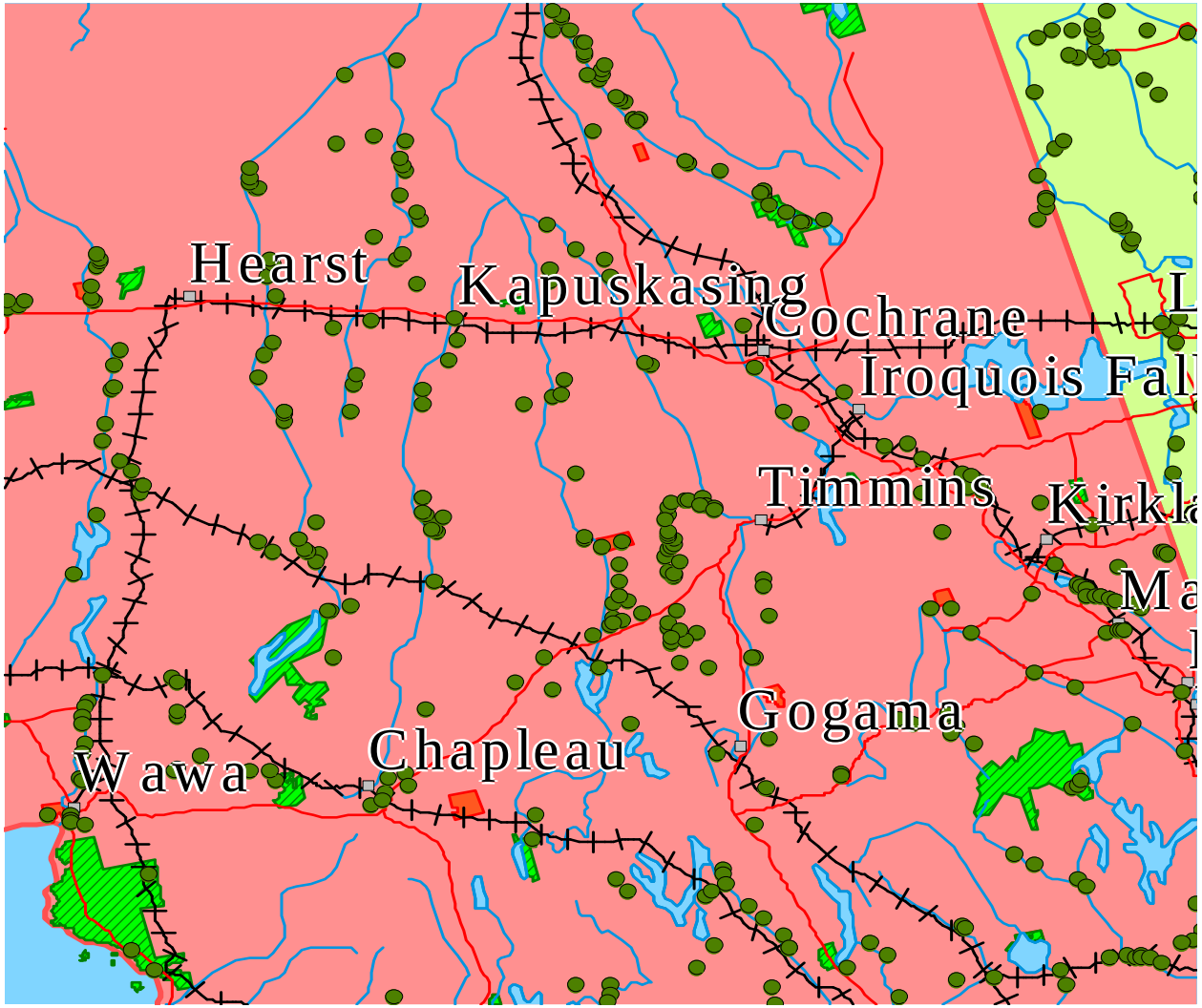
Reliable renewable energy



Geographic distribution and security



Our “resource” inventory



Practical* Potential

- Short term –
  - > 1,000 MW within the next 5 years
- Within the planning horizon

  - 150 to 250 MW of potential at greenfield sites of less than 10MW

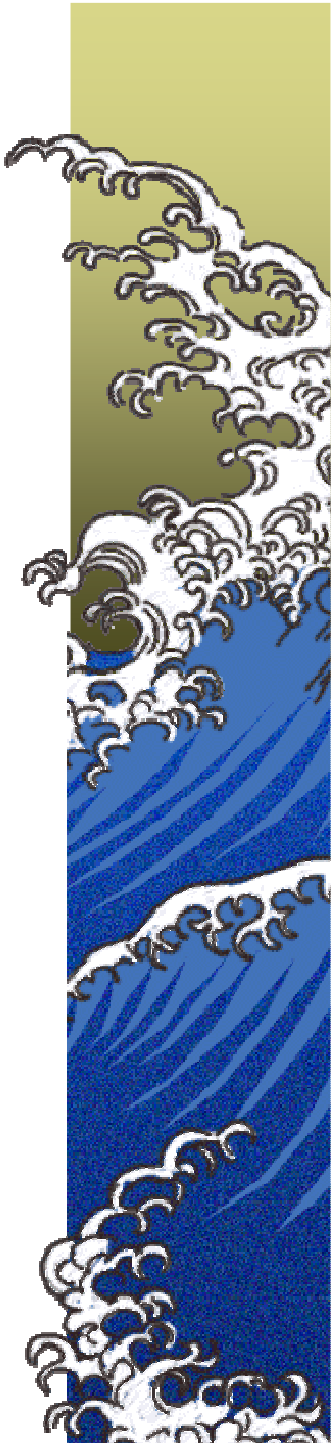
  - 400 – 500 MW of potential exists at greenfield sites between 10MW and 100MW

  - 3,000 – 4,000 MW at known larger sites

  - redevelopments and new powerhouses at existing dams could add almost 200MW

  - pumped storage projects can be relied upon to contribute up to 1000MW

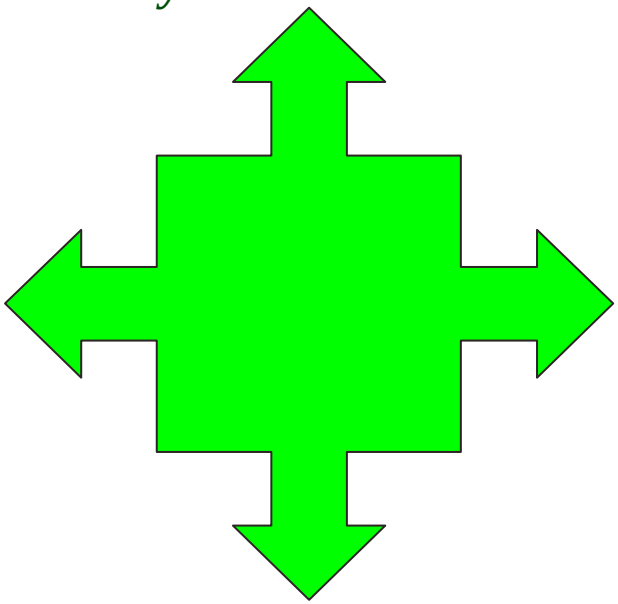
  * = PXE



Key Challenges

Environmentally Sustainable Economic Development

Biodiversity



Ecological Sustainability

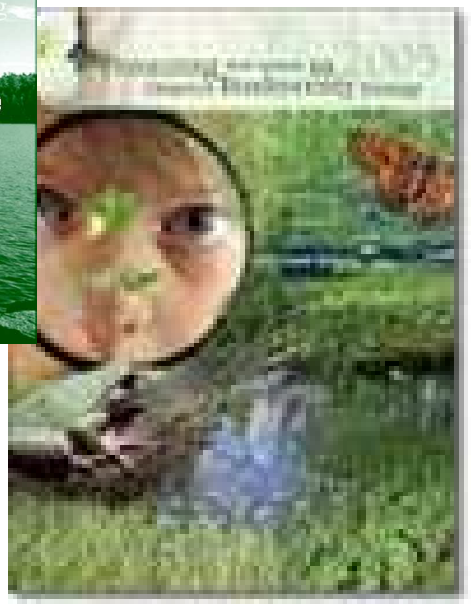
Ecological Integrity

Energy is not“valued”

LANDS *for* LIFE

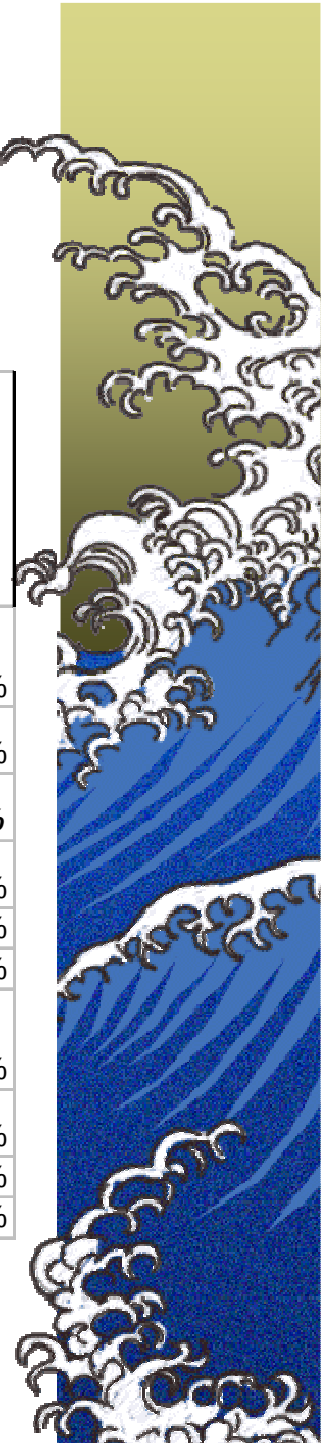
Ontario

Ontario's Living Legacy



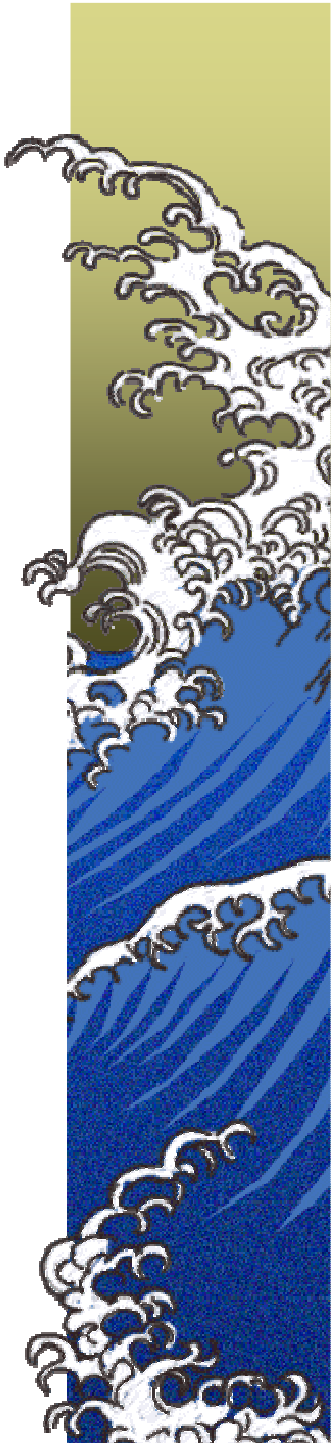
Parks and Waterpower

Protected Area Designation	Existing (#)	New / Additions (#)	Total Number	Existing Area (ha)	Net Area of New, Additions & Reclassifi-cations (ha)	Total Area (ha)	% land increase
Wilderness Provincial Park	5	0 / 2	5	1,797,177	31,688	1,828,865	1.76%
Natural Environment	49	Dec-21	61	1,106,426	277,658	1,384,084	25.10%
Waterway	***24***	***37 (-1) / 13***	***60***	***333,128***	***578,279***	***911,407***	***173.59%***
Nature Reserve	67	13-Jul	80	83,743	18,711	102,454	22.34%
Recreation	37	0 (-1) / 2	36	30,234	1,853	32,087	6.13%
Historical	3	1 / 0	4	1,858	5,163	7,021	277.88%
Total Provincial Parks	185	61 / 45	246	3,352,566	913,352	4,265,918	27.24%
Conservation Reserves	29	271/ 1	300	63,867	1,473,327	1,537,194	2306.87%
National Parks	2	0	2	186,521	0	186,521	0.00%
TOTAL	216	332/ 46	548	3,602,954	2,386,679	5,989,633	66.24%



A Case Example – Mississagi River

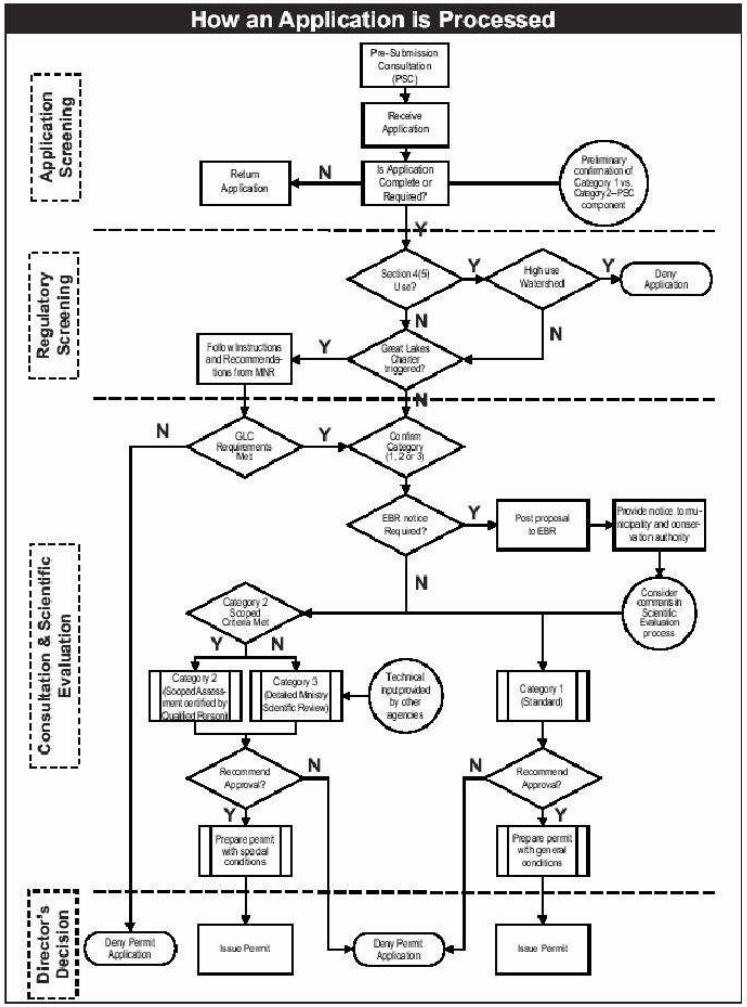
- 490 MW load-following waterpower production (strategic assets)
- Significant new development potential (Patten Post), part of provincial supply plan
- Mandated OPG decontrol (Budget contribution)
- Living Legacy Waterway Park
- Who did the math? What was counted?



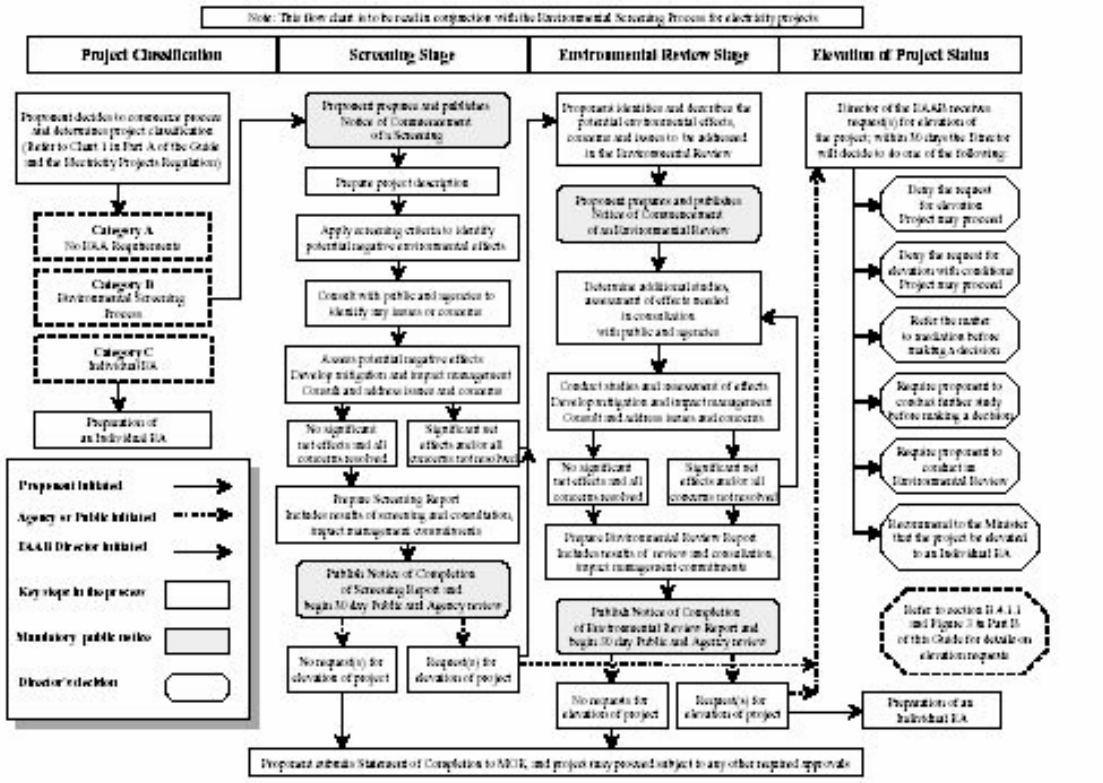
Policy Silos

- Waterpower is at the convergence of two critical public goods – water and electricity
  - Overlap, duplication and red-tape
  - E.g. – energy production reported to:
    - MOF
    - IESO
    - MNR
    - MOE
    - OEB
    - OPA?

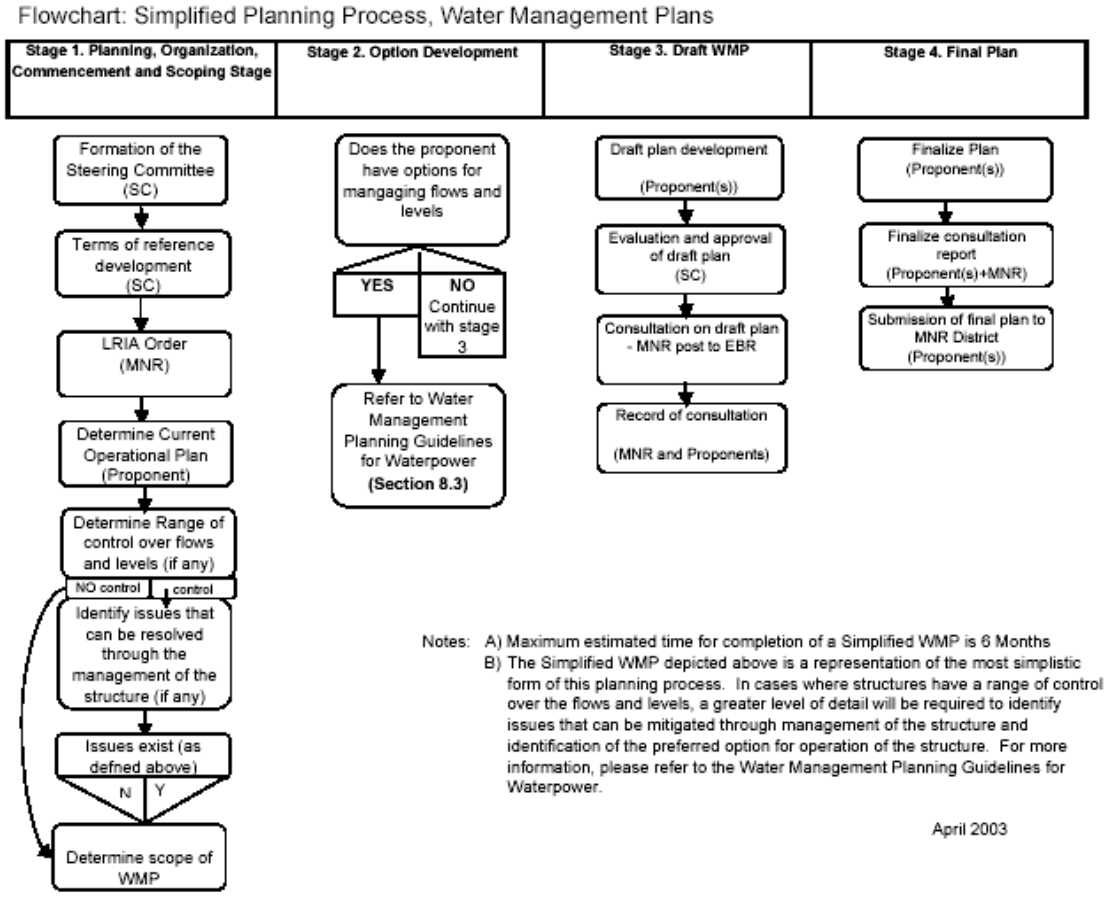
Environmental Approvals



Environmental Approvals

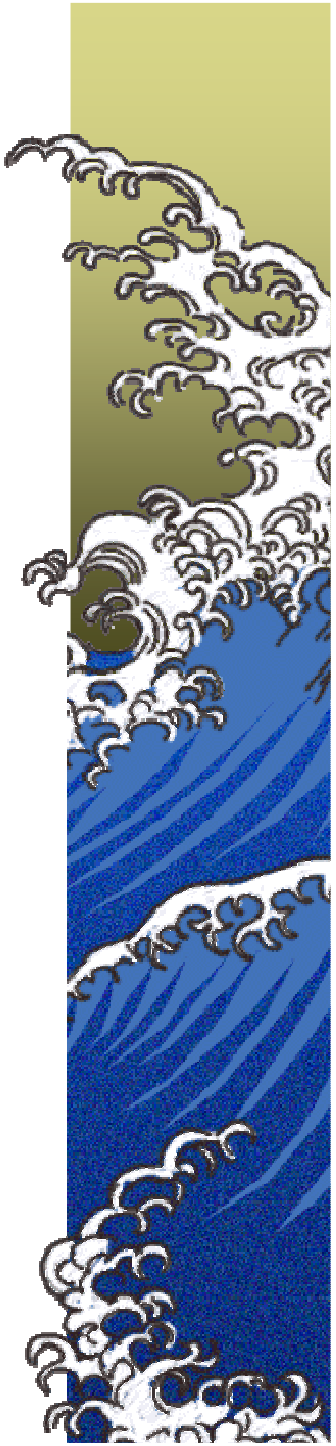


Environmental Approvals


Flowchart: Simplified Planning Process, Water Management Plans
Stage 1. Planning, Organization, Commencement and Scoping Stage
Stage 2. Option Development
Stage 3. Draft WMP
Stage 4. Final Plan
Formation of the Steering Committee (SC)
Terms of reference development (SC)
LRIA Order (MNR)
Determine Current Operational Plan (Proponent)
Determine Range of control over flows and levels (if any)
NO control
control
Identify issues that can be resolved through the management of the structure (if any)
Issues exist (as defned above)
N
Y
Determine scope of WMP
Does the proponent have options for mangaging flows and levels
YES
NO Continue with stage 3
Refer to Water Management Planning Guidelines for Waterpower (Section 8.3)
Draft plan development (Proponent(s))
Evaluation and approval of draft plan (SC)
Consultation on draft plan - MNR post to EBR
Record of consultation (MNR and Proponents)
Finalize Plan (Proponent(s))
Finalize consultation report (Proponent(s)+MNR)
Submission of final plan to MNR District (Proponent(s))
Notes: A) Maximum estimated time for completion of a Simplified WMP is 6 Months
B) The Simplified WMP depicted above is a representation of the most simplistic form of this planning process. In cases where structures have a range of control over the flows and levels, a greater level of detail will be required to identify issues that can be mitigated through management of the structure and identification of the preferred option for operation of the structure. For more information, please refer to the Water Management Planning Guidelines for Waterpower.
April 2003

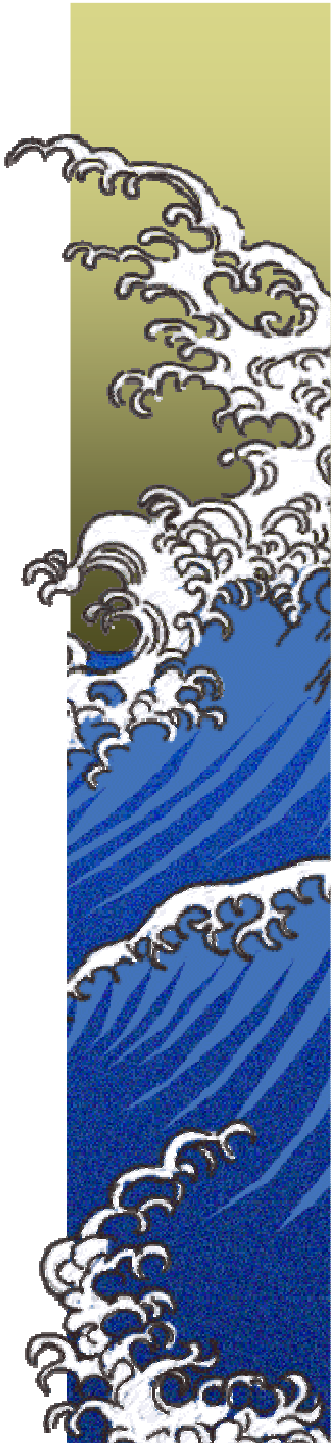
Transmission – the left hand

- Renewables RFPs
  - All Waterpower eligible
    - New Development
    - Re-development
    - Upgrades
- No dispatchable generation
- 50MW transmission limit in Northeastern Ontario
- 20 MW RFP on the Kapuskasing River
- Conawapa – a facilitation opportunity?



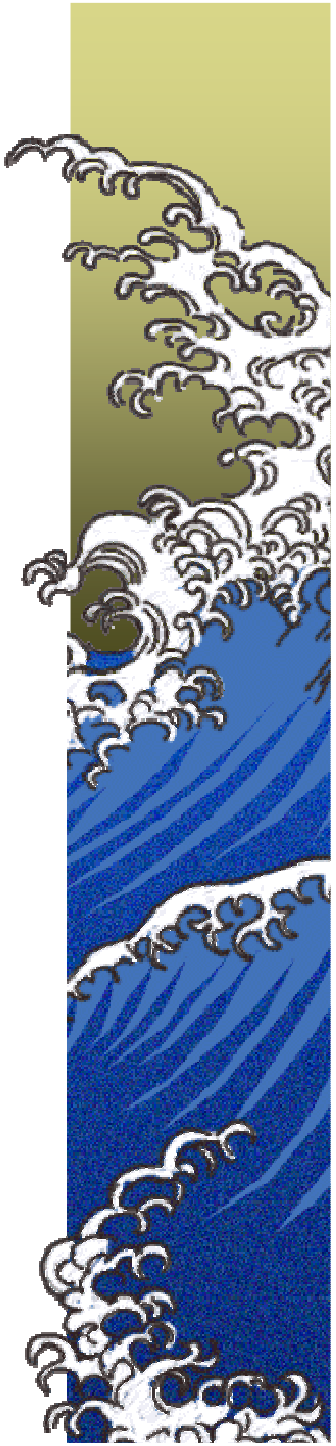
It is where it is…..

- Crown Land Development Policy
  - Implicit moratorium until Nov 2004
  - Multiple (competing?) policy objectives
    - Renewable energy
    - Aboriginal Economic Development
    - Ecological Sustainability
  - “Competitive” Release Process
    - Success = Opportunity
    - No guarantee of contract
    - No guarantee of tenure
  - Significant potential deferred
    - 4 Northern Rivers (25MW Limit)
    - Moose River Basin – lead for “co-planning”?
    - Ontario Hydro Non-Statutory right of first refusal



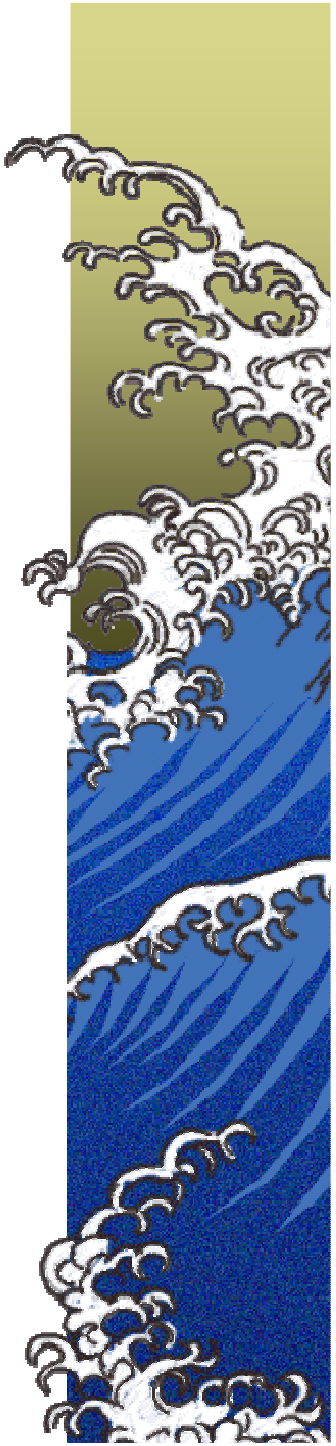
Resource management and energy production

- Water Management Planning (2002)
  - Systems/adaptive approach to “waterpower rivers”
  - (Re?)- balance of social, economic, environmental objectives
  - Increase net benefit to society
  - Legislated requirement for all facilities
  - “Natural Flow Regime” Paradigm
  - Restrictions on operational flexibility
  - IESO identified system concern



Our advice

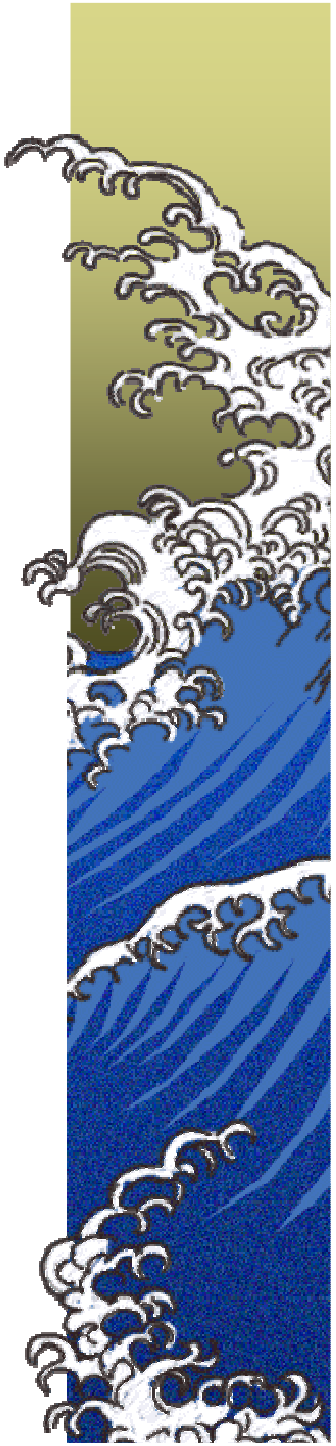
- Challenge the assumptions
  - Ontario has practical unrealized potential
  - Waterpower and other values can co-exist
- Re-frame the question
  - Renewable energy as a “matter of provincial interest”
  - MWhrs in addition to MW
- Align the interests
  - One project, one process
  - Proactive planning



Where there's a will…

"Our government is interested in maximizing every source of renewable energy that is available to us. We are particularly interested in expanding our supply of hydroelectric power. Through our request for proposals for renewable power and through the efforts of my colleague the Minister of Natural Resources, we are removing barriers to achieving Ontario's potential for additional water power in our province. Why? Because it's clean, affordable, sustainable and reliable"

Ontario Minister of Energy – March 31, 2005



There’s a way

OPA Meeting
21 September 2005, 9:00 – 10:00 am

Bryan Karney, Stan Pejovic

Civil Engineering Department, University of Toronto

STABILITY OF PRICE AND POWER PRODUCTION OF CLEANER ELECTRICITY IN ONTARIO

Optimisation

Best Efficiency – Free Spinning Reserve - Stability

Prof. Stan Pejovic, Ph.D., P.Eng.
E-mail: stan.pejovic@utoronto.ca
pejovics@asme.org
Website: http://fon.fon.bg.ac.yu/~cane/

Good morning.

My name is Stan Pejovic.

I am formerly Prof. of Mechanical Engineering, U. of Belgrade, and now part-time professor. and research associate at the University of Toronto.

We'd thank you for allowing us the opportunity to express our views here today.

Content

- Who am I ?
- Education of experts
- Optimisation and Supply mix
    - Spinning reserve
    - Priorities
    - Price and price variation
    - Computer programs
- Nuclear plants
- Nuclear/coal combined with pumped-storage
- Hydro power and pumped storage plants
- Role with renewable energy

- Who am I?

Some of my designs

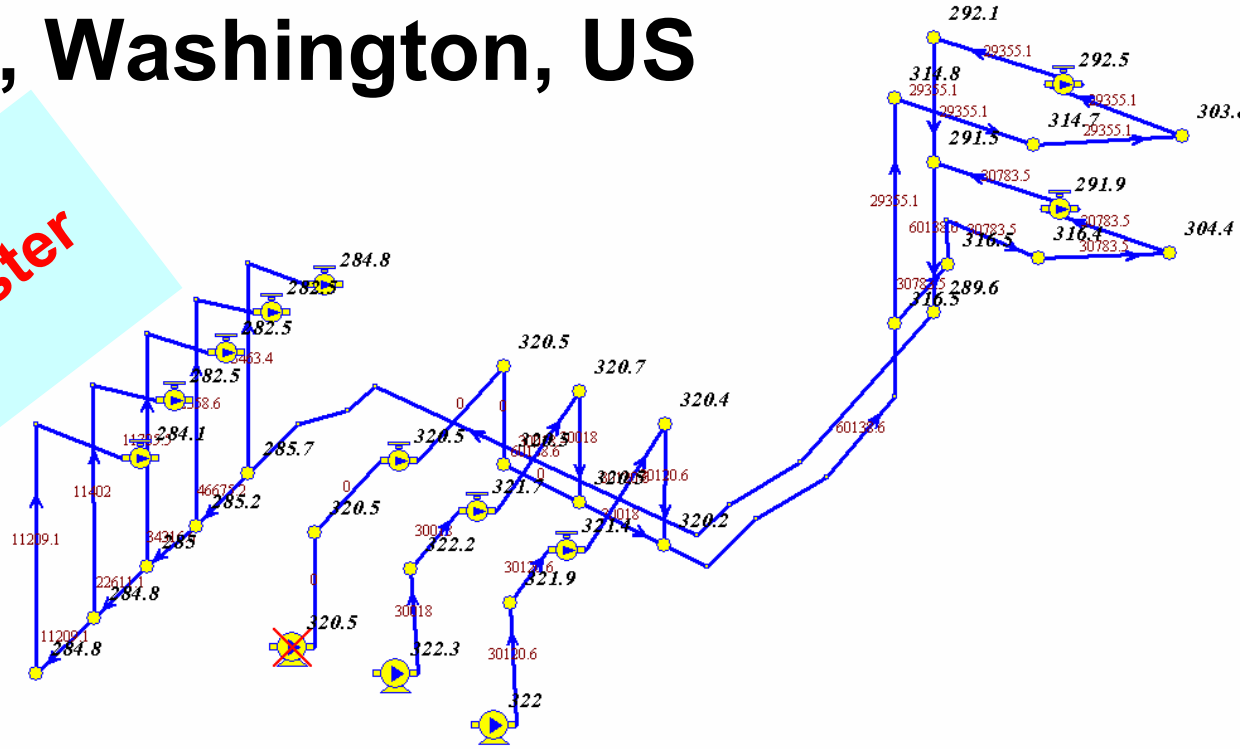
My first transient analysis

"Nikola Tesla" Thermal Power Plant
(Total 2800 MW)

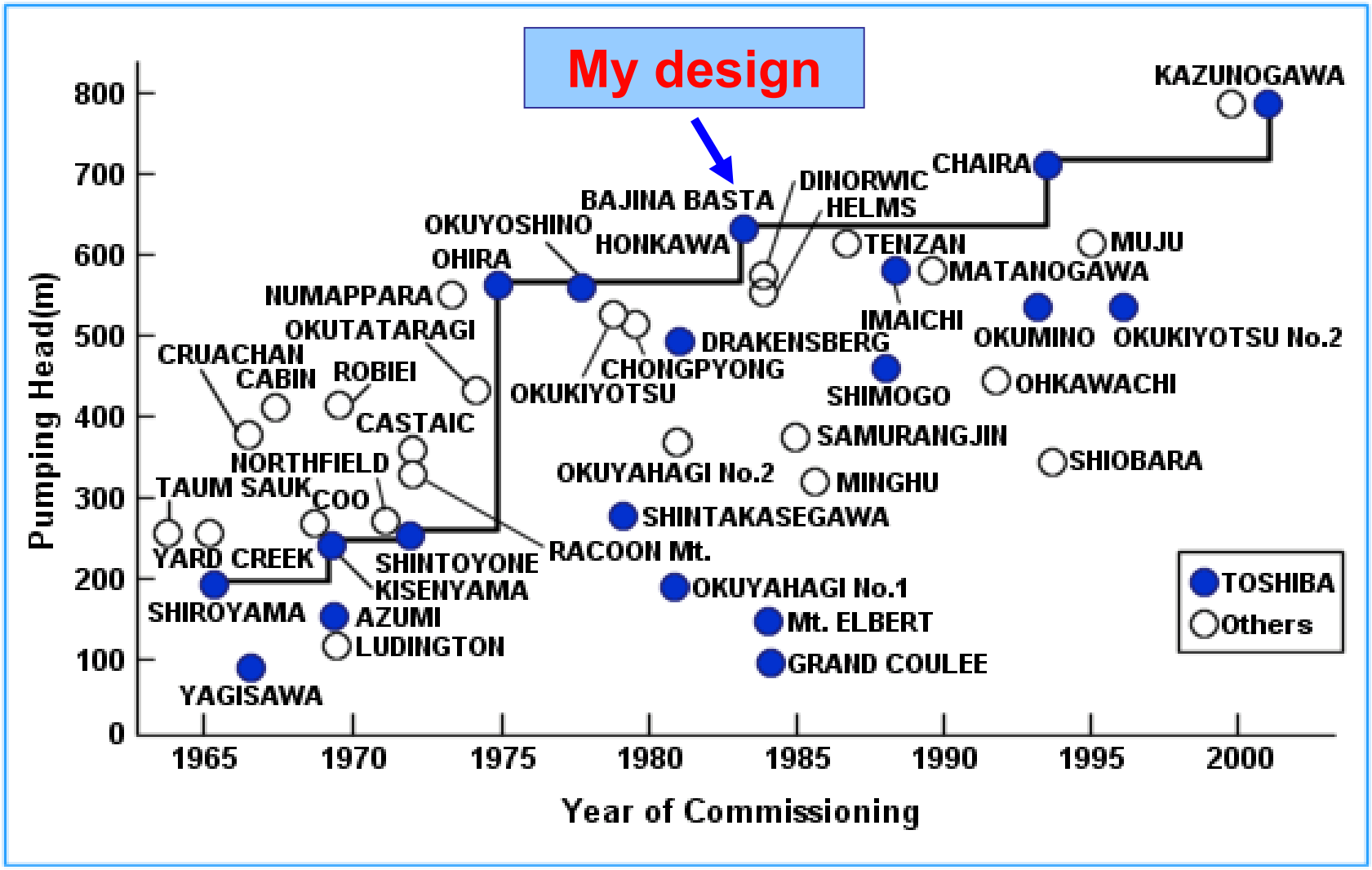
My recent transient analysis 2002

- **Big Hanaford Combined Cycle Plant**
- **Centralia, Washington, US**

Full contract Stone&Webster Canada



Single Stage Pump-Turbine heads:
zero up to 782 m
Progress in Pumping Head of Pomp-Turbines

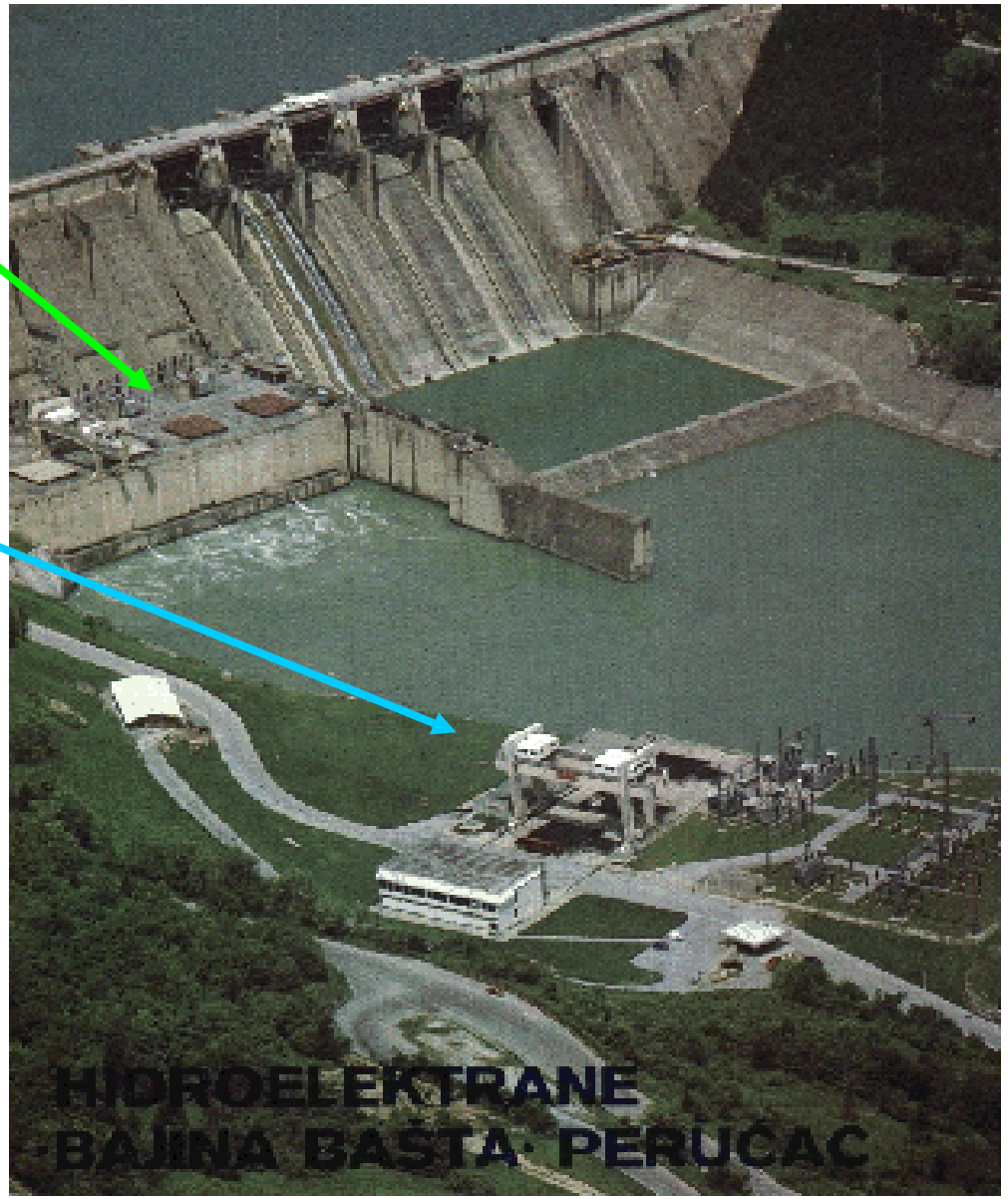


My First Experience

4x90 MW

4x150 m^3/s

Pumped Storage Plant Bajina Basta



My project 600 MW

Feasibility study

.

to

.

Trial operation

2 Pump

Turbine

Motor

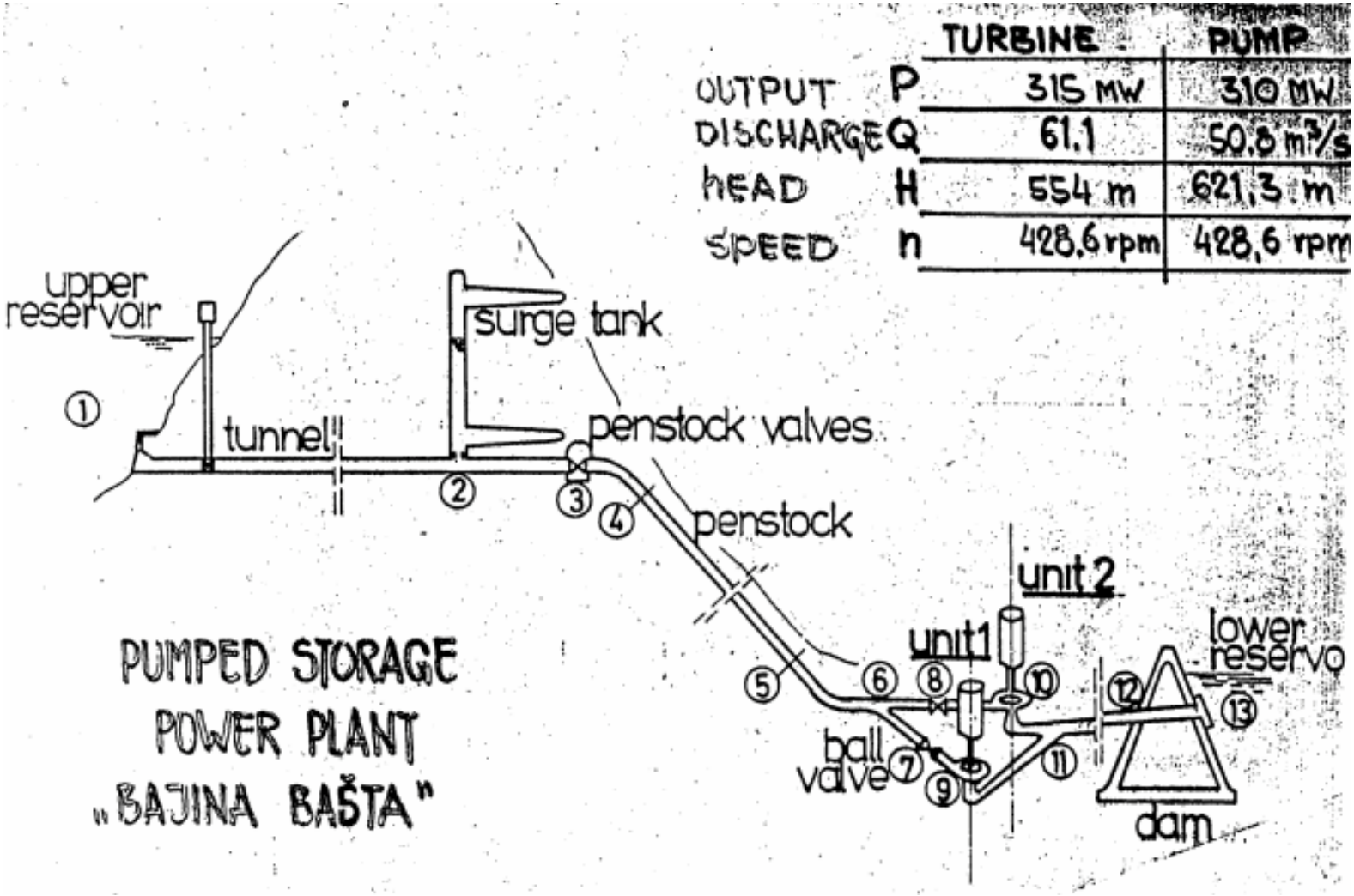
Generator

units

Each

300 MW

Pumped Storage Plant Bajina Basta
2 Pump-Turbine Motor-Generator units Each 300 MW



Requirements for New Graduates
end
Experts

- New graduates, particularly Masters or PhD
- Should have 10 to 15 years of design experience
- Should have 10 to 15 years site experience
- Able to select and read journals and textbooks.
- When few experts, learning time should be increased

  – Number of accidents and errors must be reduced
  – Education costs ***millions***, accidents cost ***billions …*** and can ***endanger lives***

- Planned multidisciplinary transfer of know-how
- Assignment facing the electricity sector and universities in Ontario and Canada
- Pivotal decisions should have already been made.

Ontario and Canadian (US) universities are not teaching students

- **to design**
- **to maintain**
- **to operate**

electric plants and auxiliary systems of big thermal power plants

OPTIMISATION ?

Supply Mix

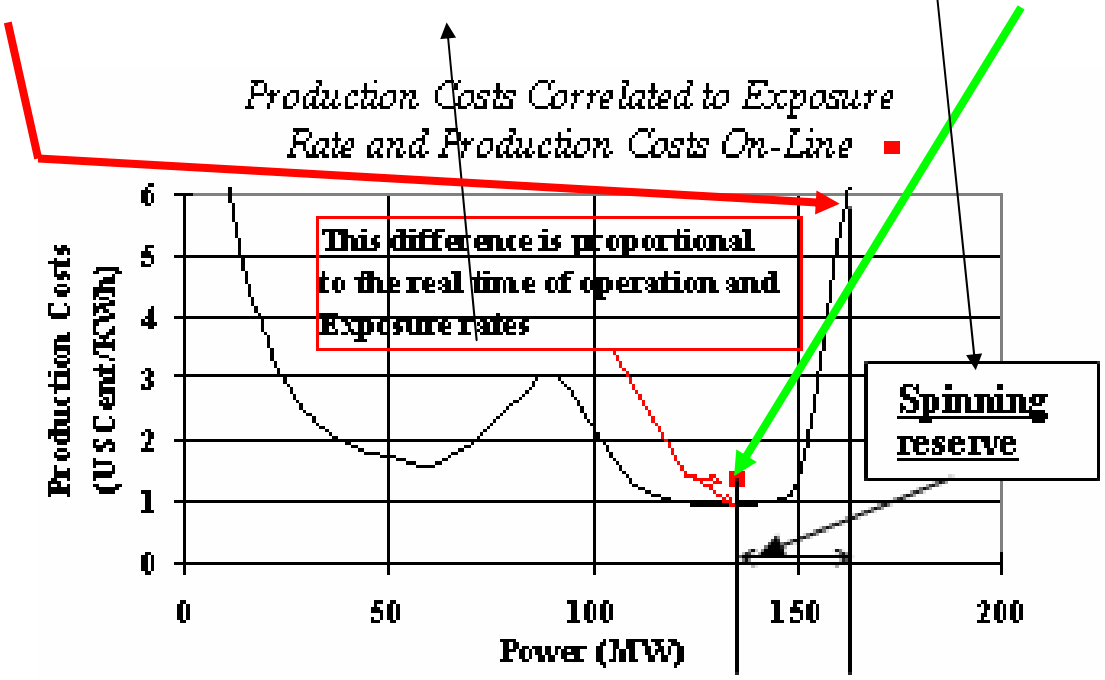
Lowers price of kWh or Maximal profit

Free spinning no load reserve

No blackouts

Characteristic Production Costs

When units operate with lowest costs, contributed spinning reserve is the difference between possible overload and current point of operation:



Spinning reserves of all running generators form total system reserve

Up-to-date Spinning Reserve

- Storage and pumped storage hydro plants are today economical and reliable solutions; lowest costs.

- Generators running hydrogen production will eventually be solution for clean fuel storage and spinning reserve.

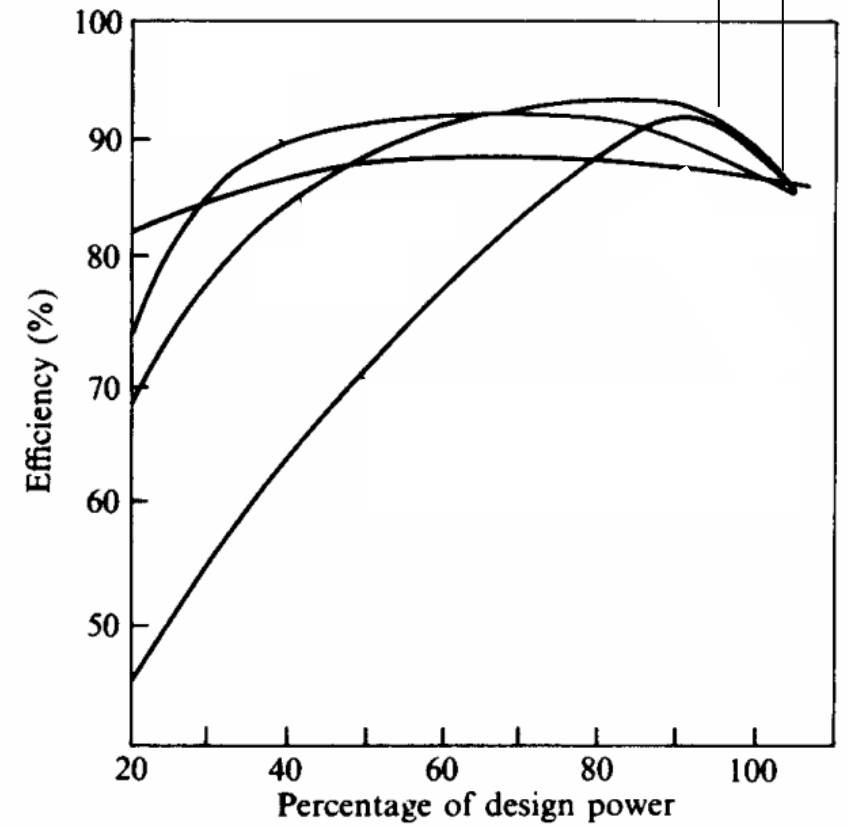
(But when?)

When all units generate at the best efficiency costs are ~minimum – ~lowest price $/kWh

Difference between power at high efficiency and design (rated) power is the cheapest (free) spinning reserve.

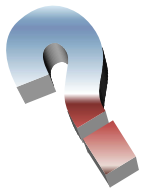
CHEAPEST

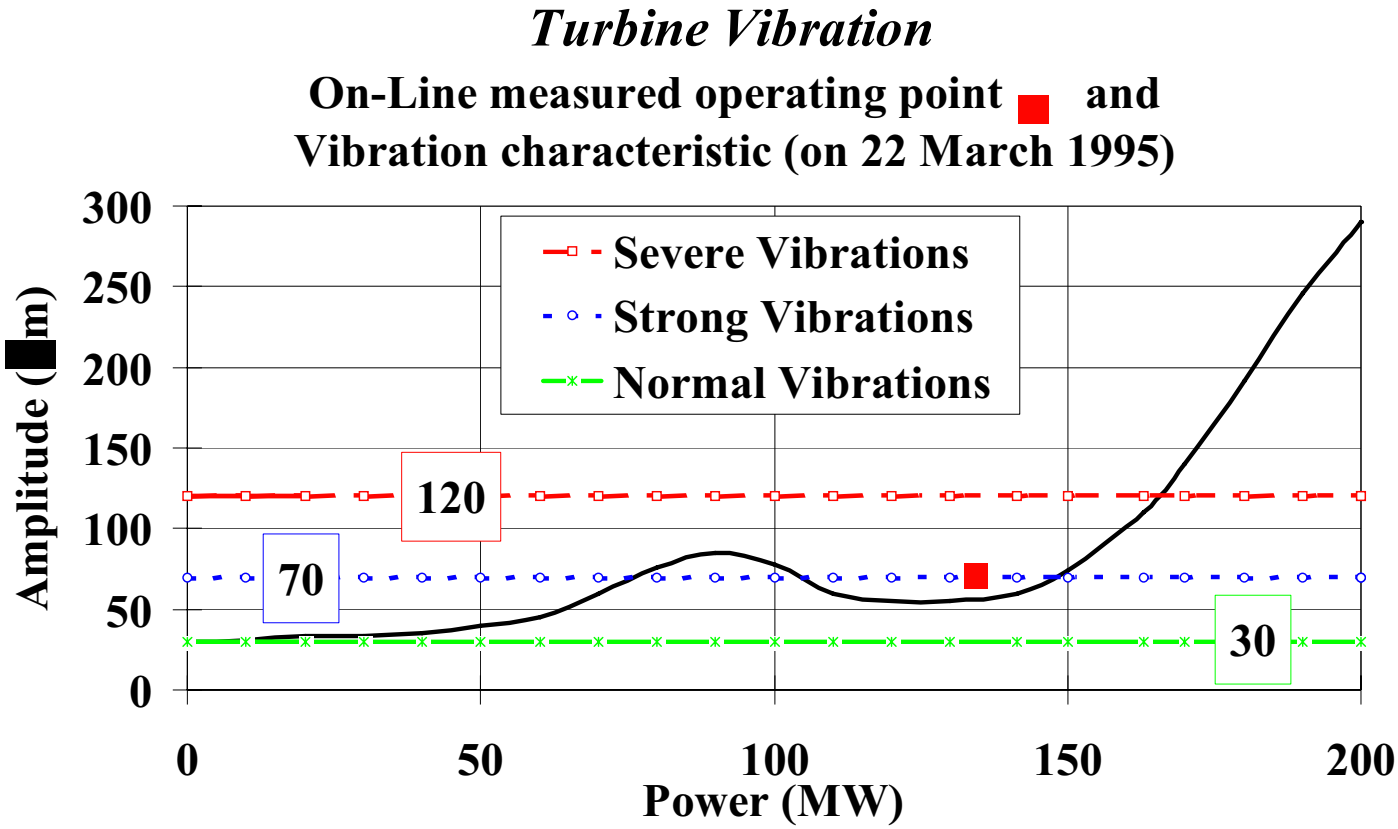
Spinning reserve



Optimisation is not so simple!

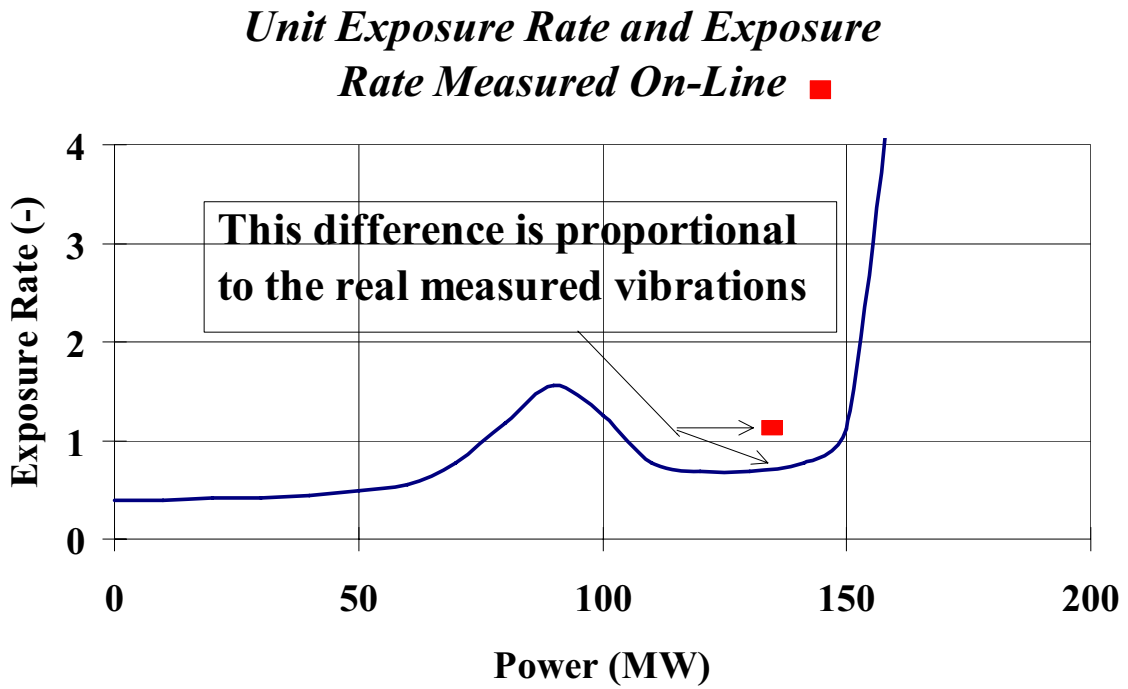
What is the meaning of optimisation?



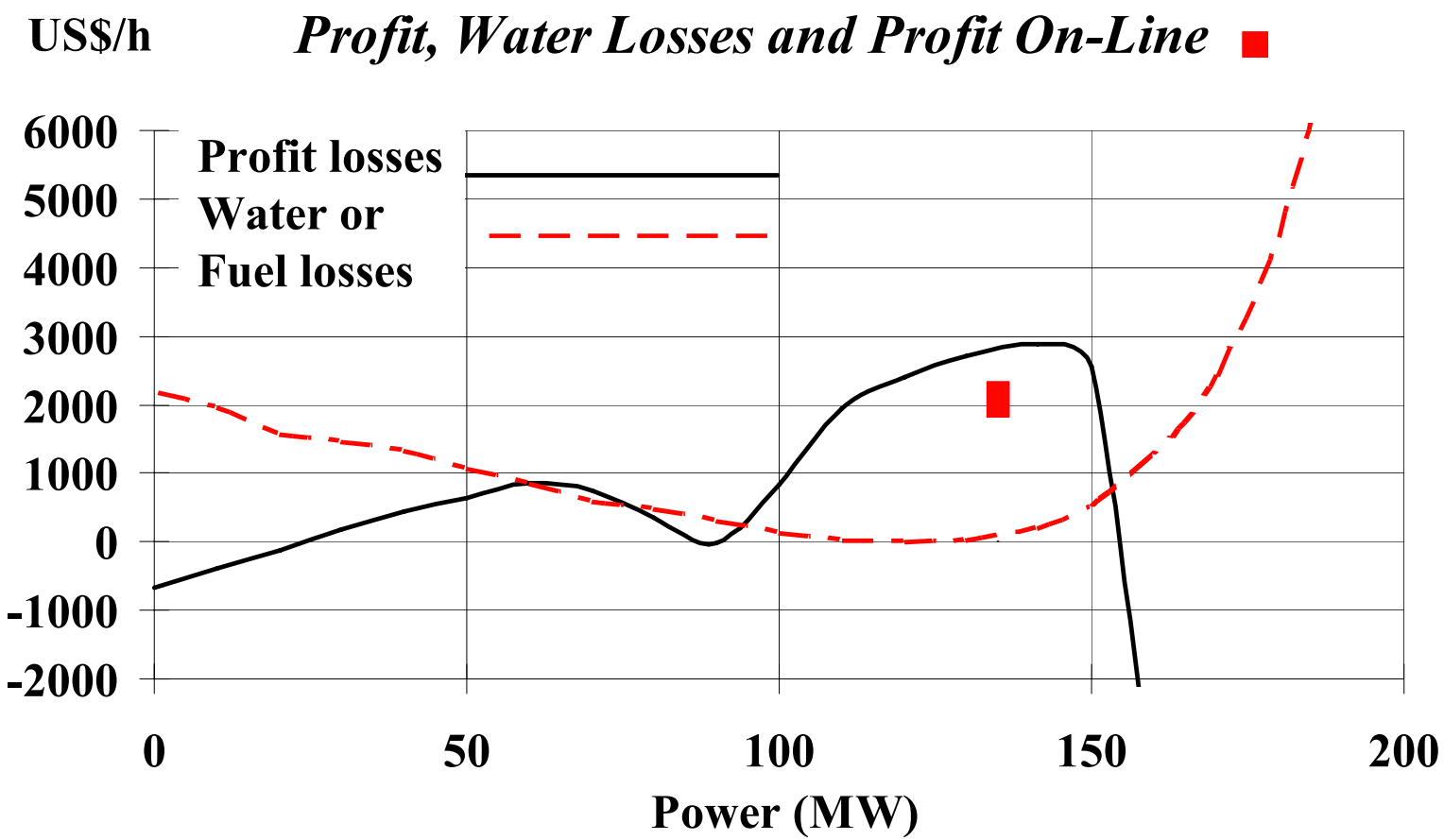


When bearing vibrations are close to prescribed limits (120 mμ), **operation is acceptable,** but only under close monitoring and supervision; if this limit is exceeded, **accidents should be expected**

$$Exposurerate = \frac{time\ of\ aging}{real\ time}$$



$$E_R = E_R(T, A, F, Q, H, n, n_s, \sigma, Type, Quality, Stress, Fatigue,$$
$$erosion, Corosion, Condensation, Air\ content, Fluid\ characteristics, \ldots)$$


US$/h
Profit, Water Losses and Profit On-Line
6000
5000
4000
3000
2000
1000
0
-1000
-2000
Profit losses
Water or
Fuel losses
0
50
100
150
200
Power (MW)

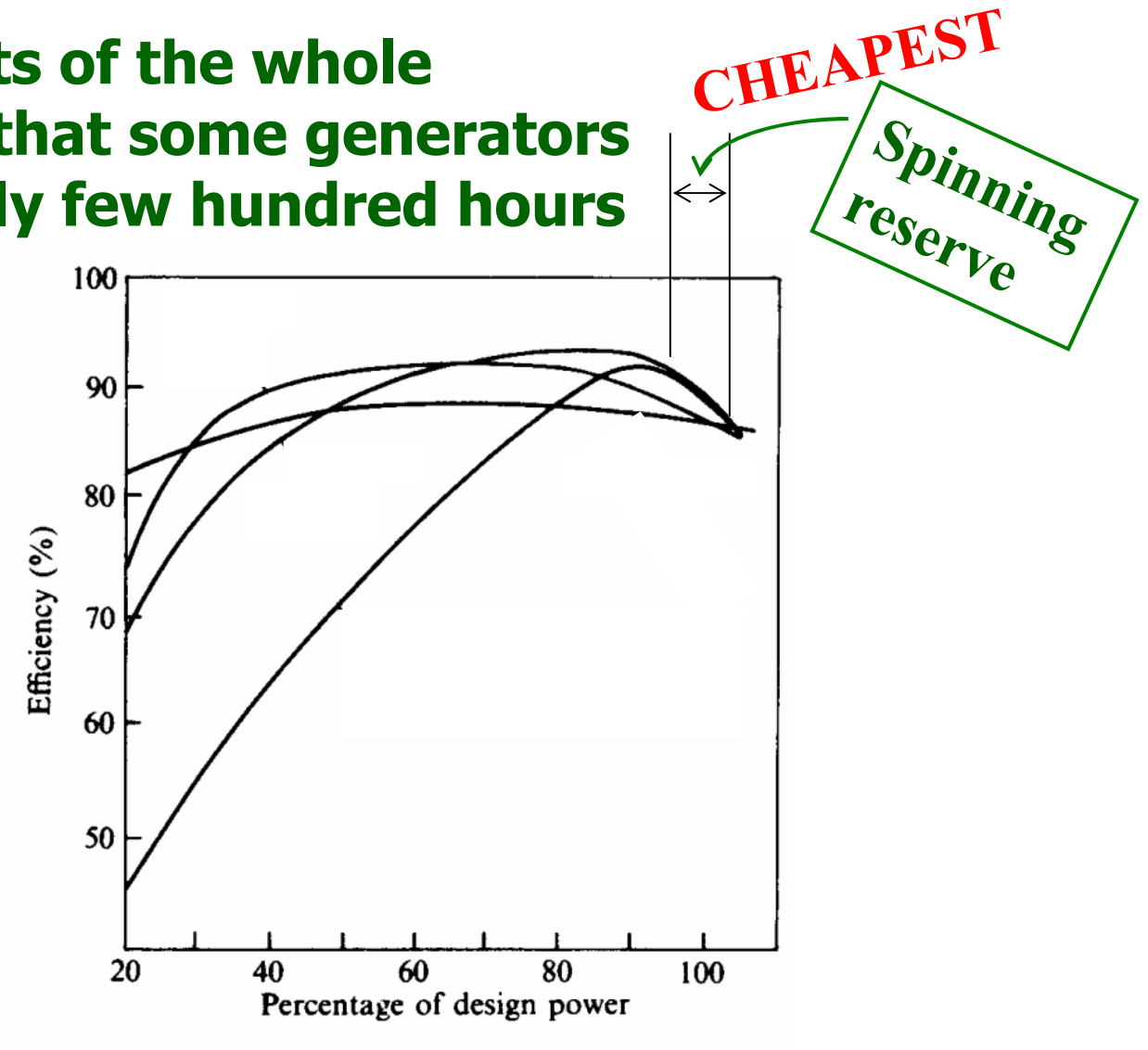
When all units generate at the best efficiency (or the lowest costs) total costs are not minimum.!

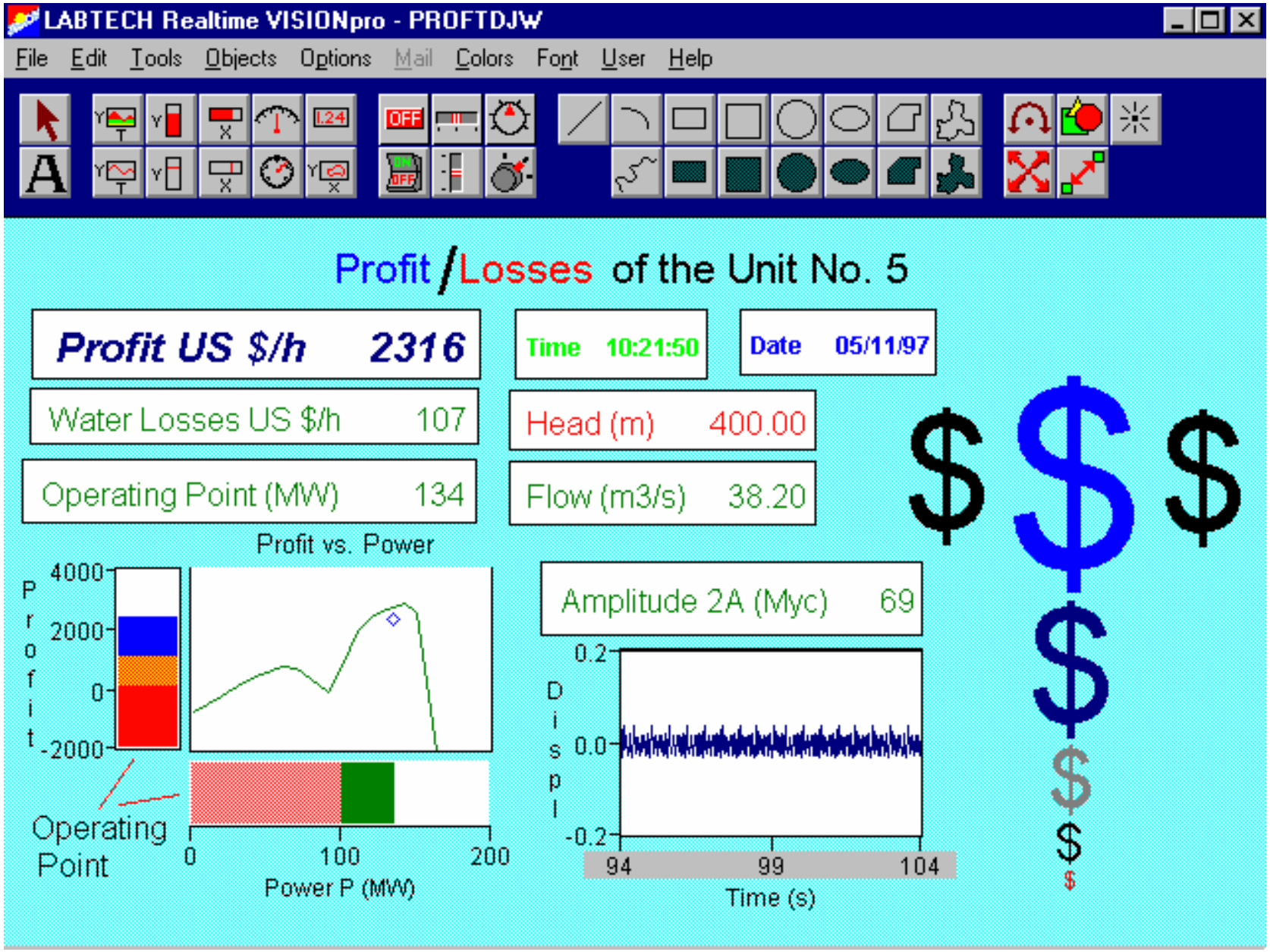
Each generator has its lowest price.

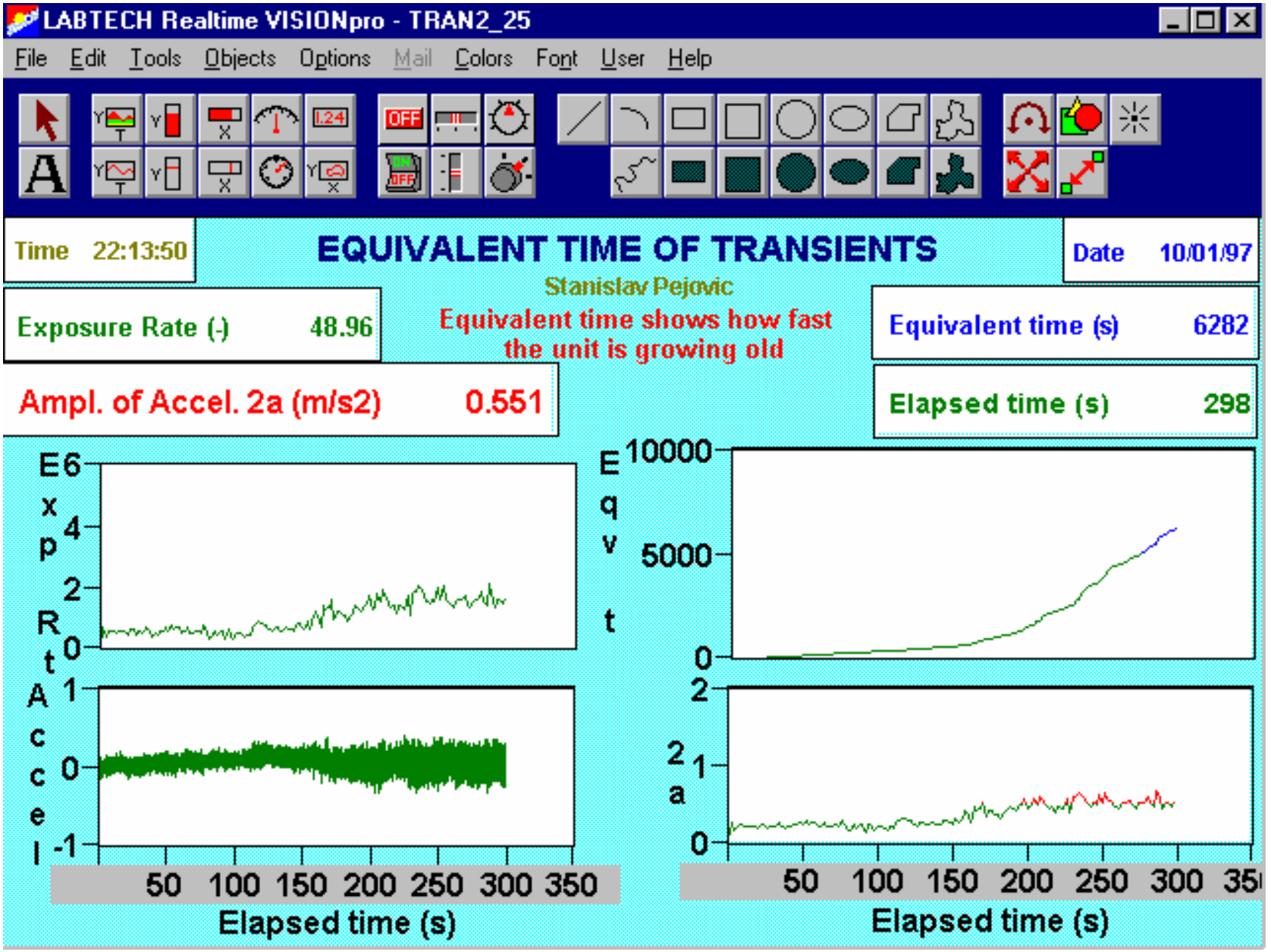
The lowest costs of the whole system means that some generators will operate only few hundred hours per year and

some will not operate at all, but system must have them as a reserve

How to pay them?




LABTECH Realtime VISIONpro - PROFTDJW
File Edit Tools Objects Options Mail Colors Font User Help
Profit /Losses of the Unit No. 5
Profit US $/h 2316
Time 10:21:50
Date 05/11/97
Water Losses US $/h 107
Head (m) 400.00
Operating Point (MW) 134
Flow (m3/s) 38.20
Profit vs. Power
Profit
4000
2000
0
-2000
Operating Point
0
100
200
Power P (MW)
Amplitude 2A (Myc) 69
Displ
0.2
0.0
-0.2
94
99
104
Time (s)


LABTECH Realtime VISIONpro - TRAN2_25
File Edit Tools Objects Options Mail Colors Font User Help
Time 22:13:50
EQUIVALENT TIME OF TRANSIENTS
Date 10/01/97
Stanislav Pejovic
Exposure Rate (-) 48.96
Equivalent time shows how fast the unit is growing old
Equivalent time (s) 6282
Ampl. of Accel. 2a (m/s2) 0.551
Elapsed time (s) 298
Exp Rt
Acceleration
Eqvt
2a
50 100 150 200 250 300 350
Elapsed time (s)
50 100 150 200 250 300 350
Elapsed time (s)

The Future

- **Ontario market must be adapted as the Power Pool to eliminate any risk to investment in any generation source.**
- Electricity from all existing and new generating facilities should be regulated to the following ends:
  - **Prices to reflect true cost of generation,**
  - **And of reserve capacity,**
  - **And public need for stable production,**
  - **And affordable power with stable prices,**
  - **And with a continual emphasis on conservation and adaptation**

Immediate Priorities

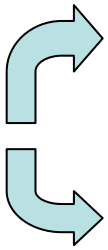
- Peak generators
- Speed no load generators
- Stand by generators
- Renewable energy production
- Transmission lines
- Energy conservation
- Production optimization

Need for Reserve

- As Banks must carry a credit reserves to avoid financial instability and runs…
- So power production must carry an operational reserve.
  - This cannot be paid for in the same way as power consumed!
  - If not put in place, the system will fail again and again….

Stable Production

- Reserve in capacity



spinning reserves

stand-by reserves

Reserve energy is not directly productive, and thus

Cannot be charged in same way as consumption!

We must pay for car insurance

but

Neither car owners nor insurance companies want accidents or claims

Ontario must be insured with running and spinning no-load reserve

or

we will all have to pay billions for blackouts

What is “spinning no load” reserve?

Minimal spinning reserve

=

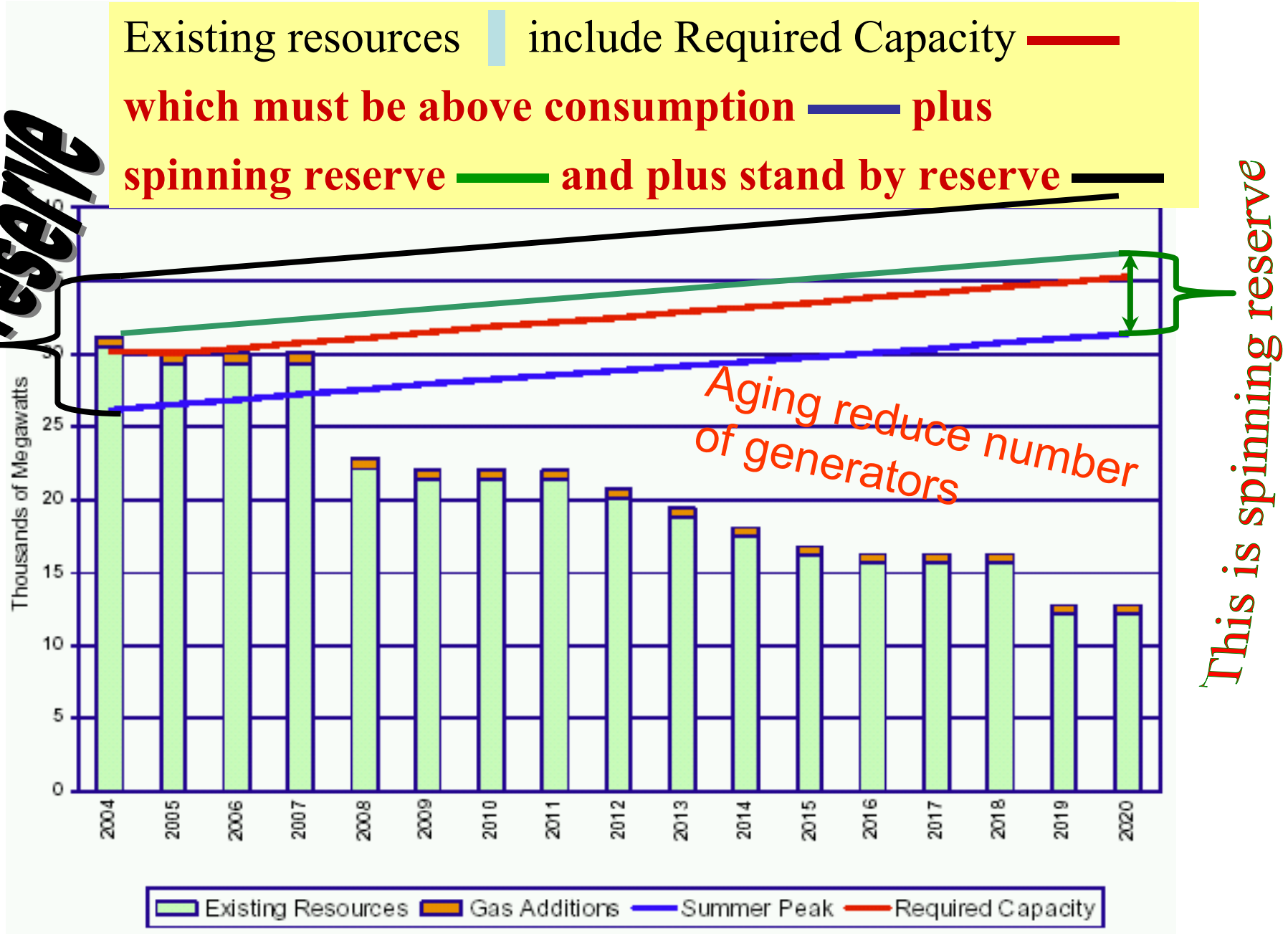
Uncontrolled drop of the biggest generator

or

the biggest power plant which could be dropped

or

power transmitted by uncertain transmission line.



Basic data from Shane Pospisil, Sep. 28, 2004

Without explicit consideration of production and spinning reserves

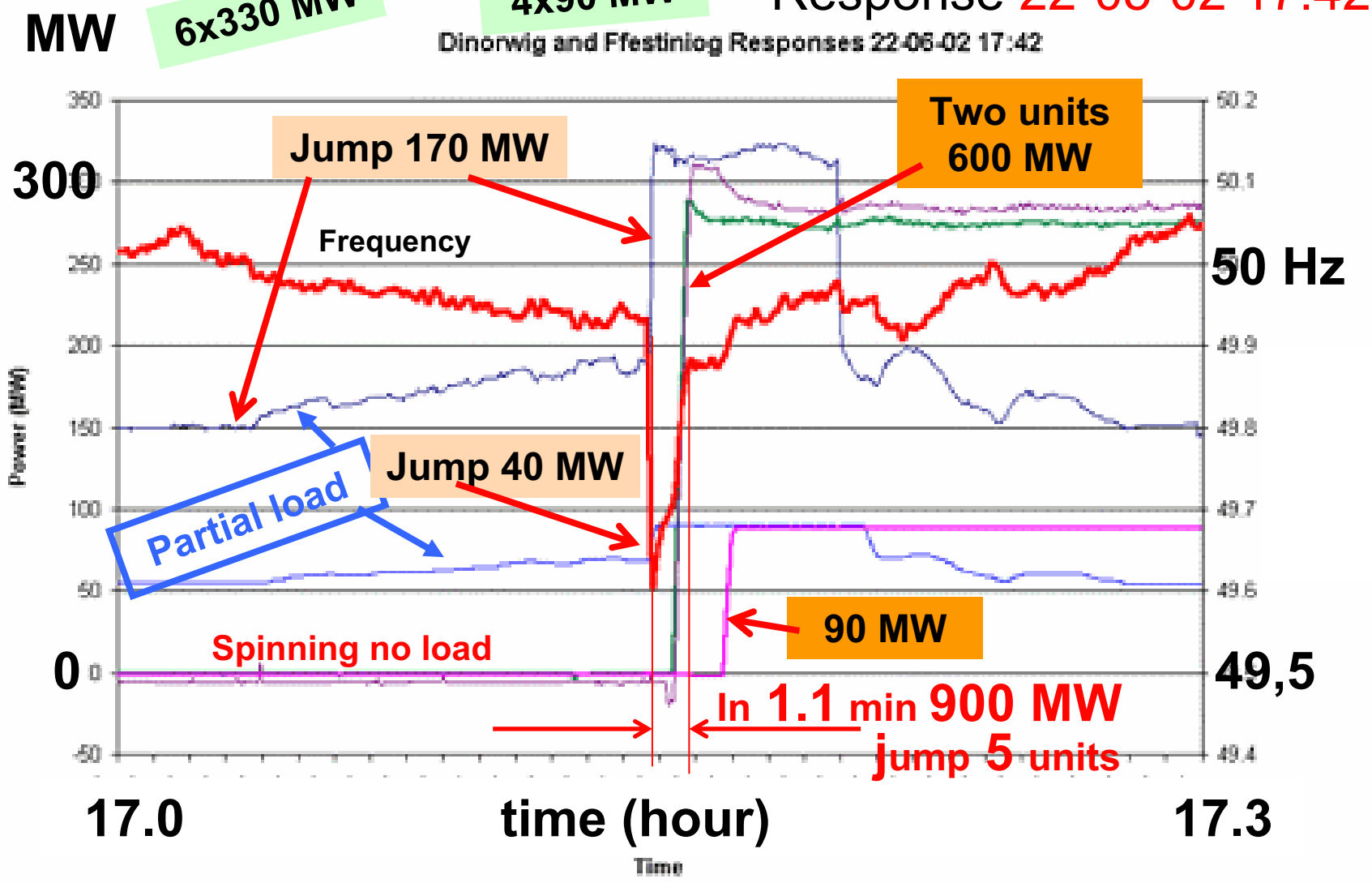
stability in the generation system cannot be achieved.

Instability create huge economic and social consequences.

BLACKOUT becomes inevitable

Dinorwig and Ffestiniog pumped storage plants - UK

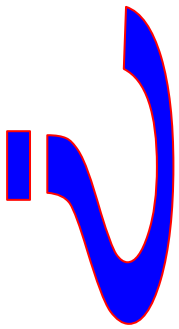
Response 22-05-02 17:42



210 MW jump in few seconds; 920 MW in few minutes

Spinning reserve

- Hydrogen (ready?)
- Hydroelectric
- Pump-storage



PRICE AND PRICE VARIATION

Even at the highest consumption, available power must exceed demand.

Key units must be ready:

- some to cover **existing demand**,
- others for **stand-by** to

quickly cover unpredictable malfunctions, and both forecast and random peaks.

NB: Reserve units do not generate revenue through electrical sales!

Spinning reserve

- Hydrogen is candidate for replacing gasoline.
- Excess power generate hydrogen and oxygen.
- Various institutions are studying technologies for generating hydrogen in large-scale amount.
- Hydrogen as a fuel **cannot be a cheap and economical storage of electricity** as the efficiency of transformation cycle (electricity surplus – hydrogen – electricity peak energy) is at the level of 40% or even less.

Hydrogen Highway is expected to be up and running by the 2010 Olympic and Paralympic Winter Games, which will take place in Vancouver and Whistler.

Hydrogen Highway is part of long-range plan to assist Canada in moving toward greater use of hydrogen fuel cells in vehicles and other power-generation applications.

Pumped storage is the most widespread energy storage system in use on power networks.

Its main applications are for

energy management,
optimisation,
frequency control, and
provision of free reserve.

Advantages

100% CLEAN
Highest efficiency
Free spinning reserve
Stability
“No blackouts”

Pumped Storage

- Excellent operational flexibility
- In standby mode, can cover peaks of demand
- By operating-in-air-either spin-pump or spin-generate improves loading performance.
- In reserve modes, uses less than 1% of rated power and can quickly change to pump or generate (not easy or cheap but possible)
- Can swing power-output widely in a few sec.
- Can operate as part-load-reserve machines.

Pumped Storage

- Works as reserve to track unexpected demand or generator failures
- Responds automatically to frequency with no operator intervention
- Contributes to quality of electric power (frequency and voltage)
- Improves reliability of system.

Generation Consumption

a Hydro run-of-river generaters

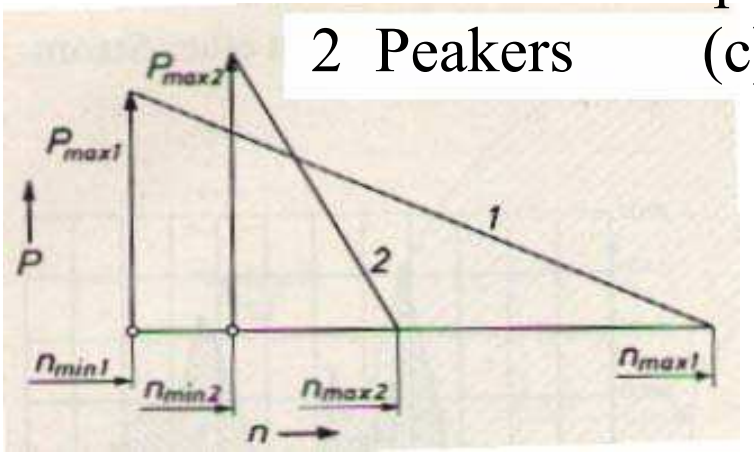
b Thermal and nuclear plants

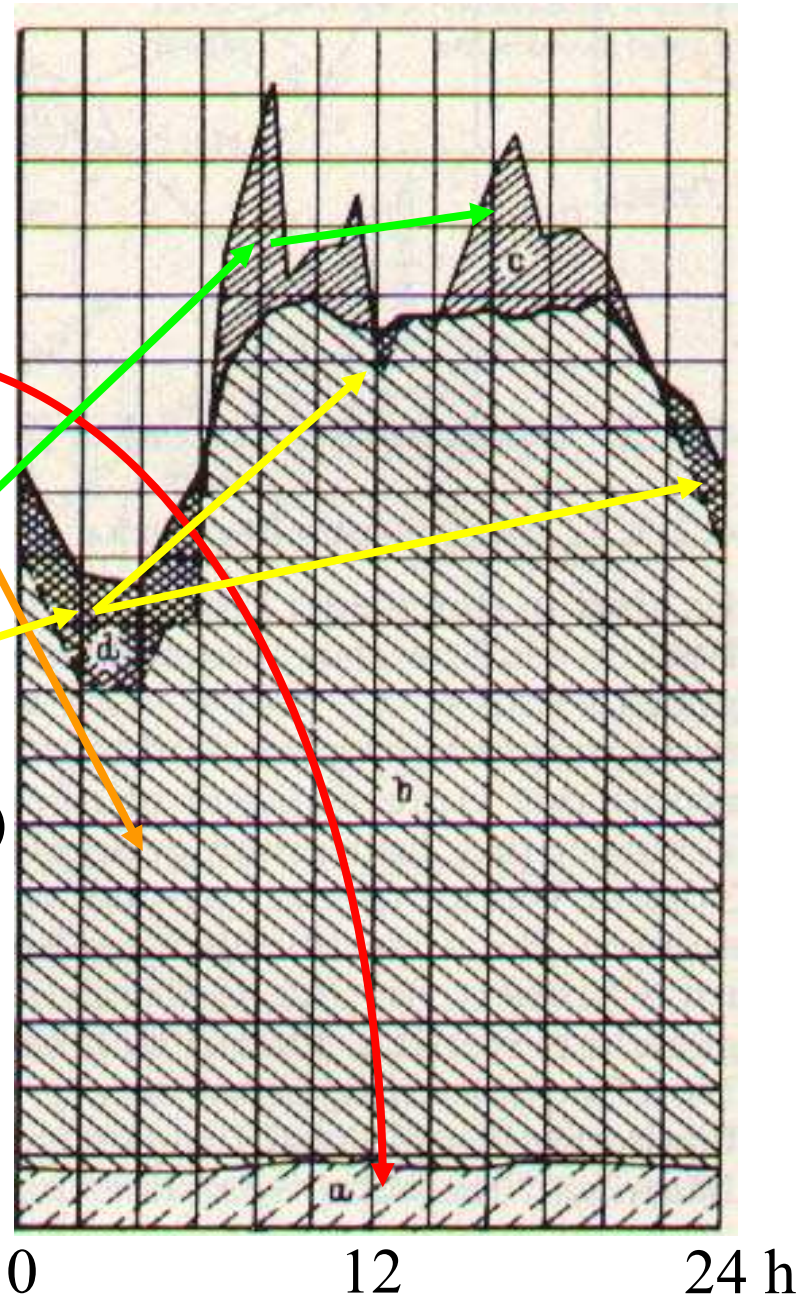
c Peakers: Storage plants & pumped-storage plants

d Pumping / storage

1 Run-of-river plants (a&b)

2 Peakers (c)





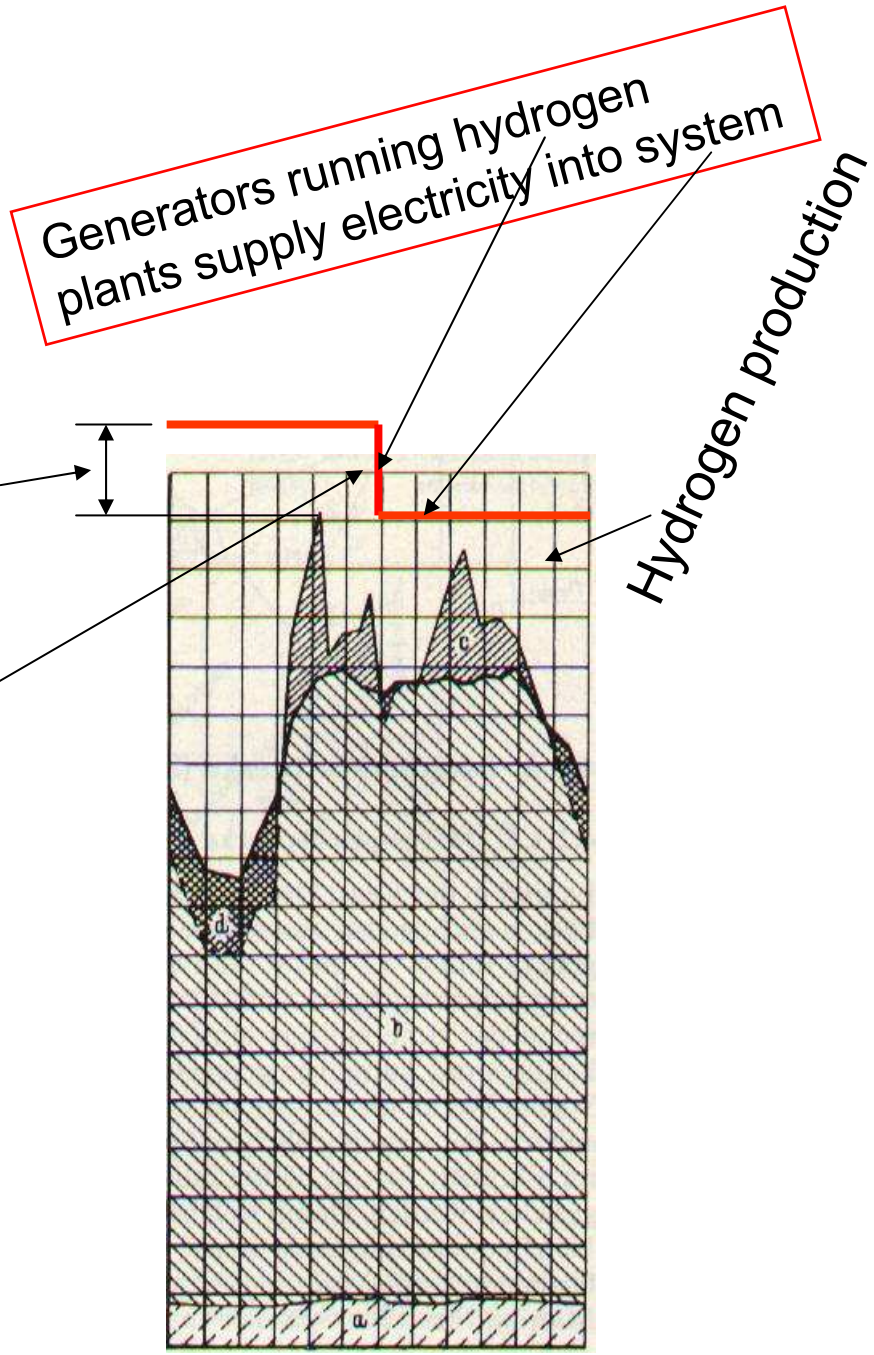
Spinning reserve

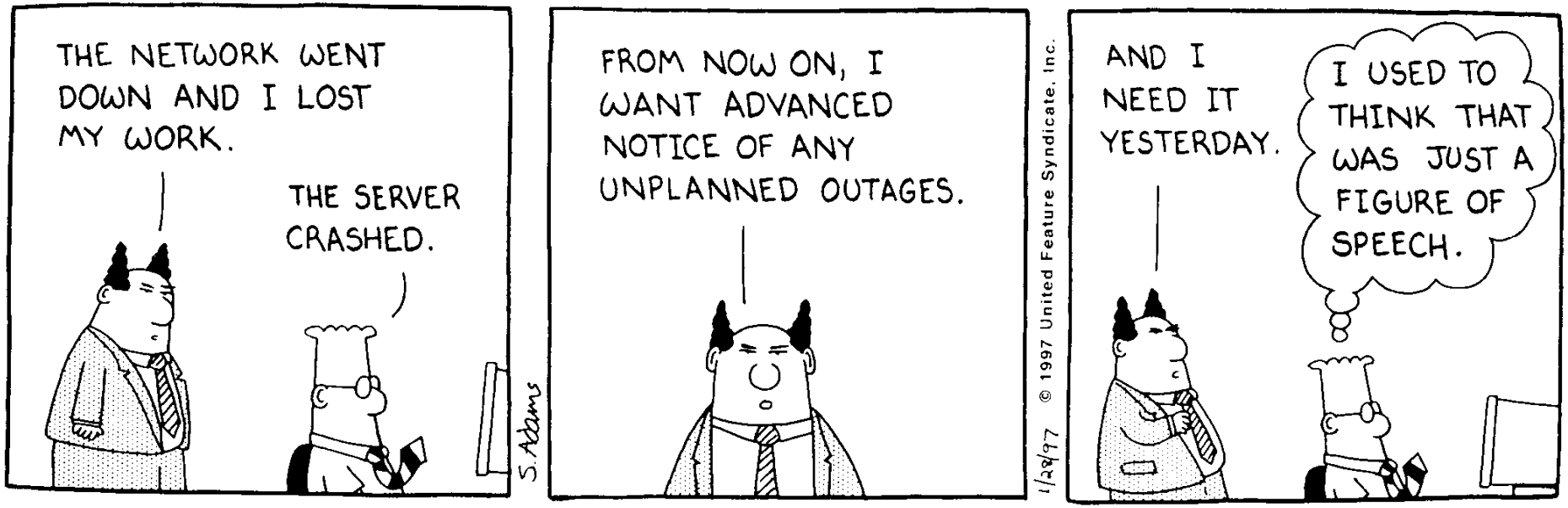
Hydrogen production must be equal to the spinning reserve

When the biggest generator system fail production of hydrogen is automatically reduced

blackout prevented.

Future 10 – 20 years?



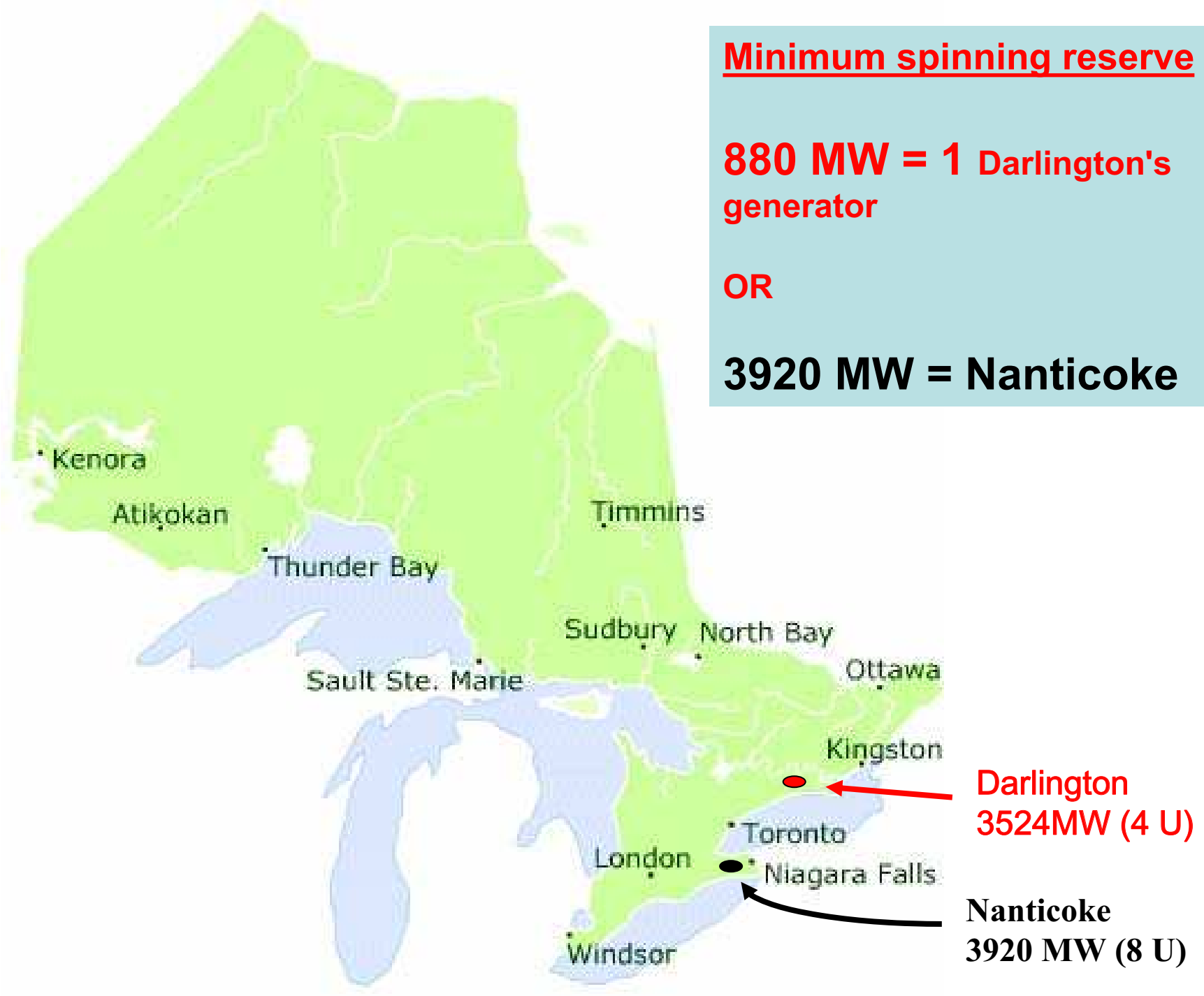

THE NETWORK WENT DOWN AND I LOST MY WORK.
THE SERVER CRASHED.
S. Adams
FROM NOW ON, I WANT ADVANCED NOTICE OF ANY UNPLANNED OUTAGES.
1/28/97
© 1997 United Feature Syndicate, Inc.
AND I NEED IT YESTERDAY.
I USED TO THINK THAT WAS JUST A FIGURE OF SPEECH.

Minimum spinning reserve

880 MW = 1 Darlington's generator

OR

3920 MW = Nanticoke



Darlington Nuclear Generating Station

4-unit station total output of **3,500 MW**

20% of Ontario's electricity needs

880 MW per unit

What must be the spinning reserve in Ontario system?

Nanticoke,
OPG coal-fired station

8x500 MW total **4,000 MW**

30+ year-old generating station

What must be the spinning reserve?

Requirement to operate in the marketplace with **many starts and stops** …

caused **equipment to break down**.

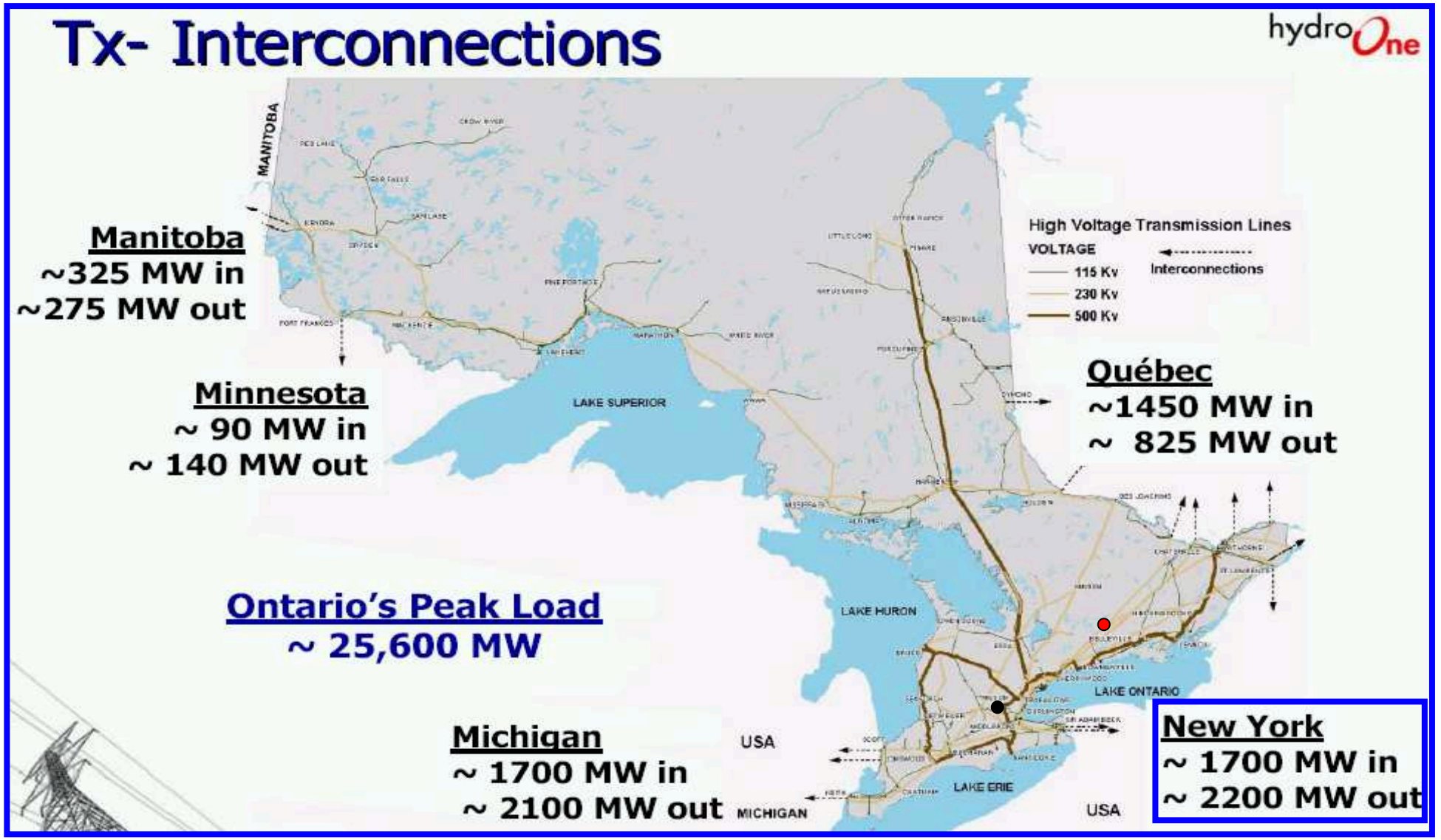
Pumped-storage the only solution

What to choose as spinning reserve?

880 MW per unit

Darlington
3524 MW (4 U)

Nanticoke
3920 MW (8 U)



US Transmission System Operation and Interconnection

Criterion for running a system is often called the **"n-1" criterion.**

Operation is based on the premise that **no single event** (such as the loss of a **line** or a **generator** or an **electric plant**) should lead to the cascading uncontrolled failure of a large portion of the system.

2003 blackout
No spinning reserve

Transmission Grid

- High capacity transmission line to connect the various provincial grids.
- Would be great benefit
- Parallel to any other improvements in energy production and storage

Maintenance

- List of equipment
- List of failure
- Inspection, vibrations and many other tests
- Planning of job and safety

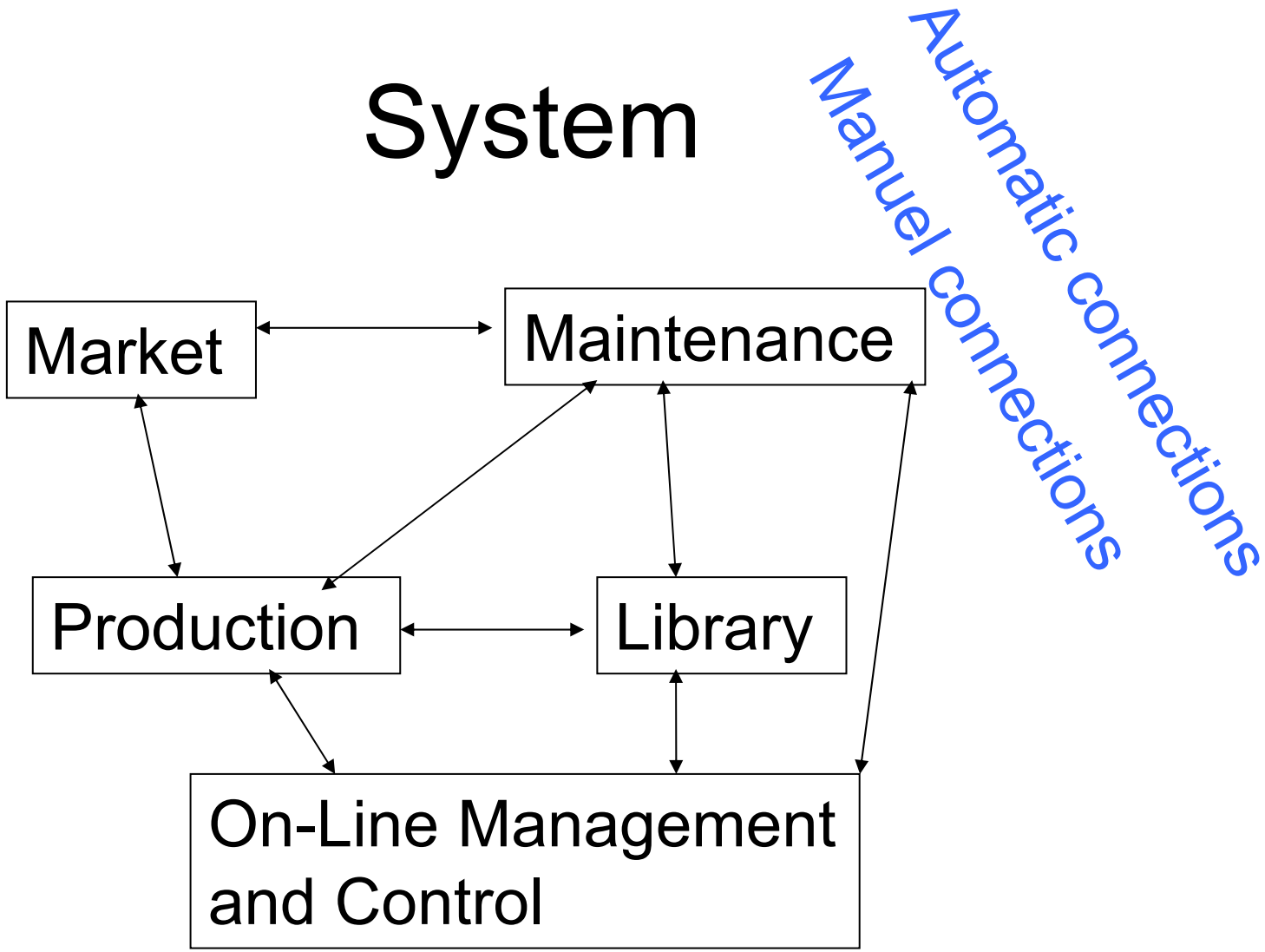
Production

- Optimisation
- Control center
- Local control of each plant
- Data acquisition
- On line information
- On line management
- Off line analyses

Market

- Expert, engineers
- Management
- Operation
- Control
- Customers
- Funds
- Stakeholders

System


Automatic connections
Manuel connections
Market
Maintenance
Production
Library
On-Line Management
and Control

Such an approach can save billions

It is time for solutions, to benefit from demonstrated knowledge and experience.

Appendix

We spoil everything:
Air, Water, Soil, …

Appendix

Clean water

A glass of drinking water

We need energy to clean environment

War for water

The End

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Tel: (905) 896-1253, Cell: 416-270-8126
E-mail: pejovics@asme.org,
Website: http://fon.fon.bg.ac.yu/~cane/

Good news NIAGARA FALLS, ON, Sept. 14 /CNW/

Niagara Tunnel

Ontario Power Generation begins Niagara Tunnel project

OPG today announced start of construction on its

$985-million, 1

0.4-kilometre Niagara Tunnel project

new, clean electricity by late 2009.

Ontario Sustainable Electricity Project

The Pembina Institute

September 2005

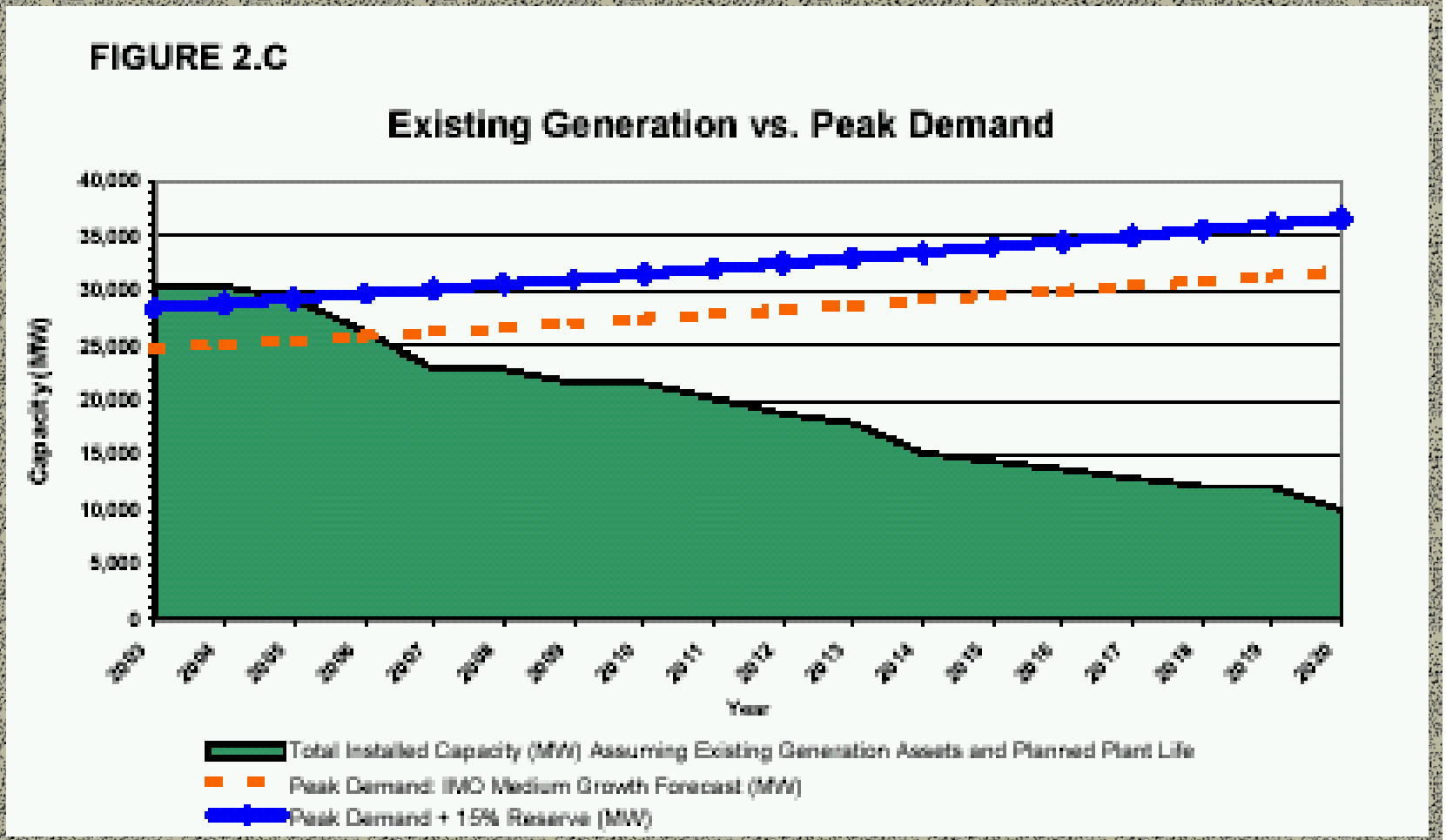
Ontario's Electricity Situation

- Demand-Supply Plan and Collapse of DSM efforts
- Ontario Hydro Restructuring and Market Experiments
- NAOP and reliance on coal
  - Health and Environmental Impacts
  - Difficulties bringing nuclear facilities back on-line
- August 2003 blackout and reliability/security of supply concerns

Ontario's Electricity Situation

- Projected end-of-life for existing nuclear and coal facilities
- Projected business as usual growth in demand

FIGURE 2.C


Existing Generation vs. Peak Demand
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
Capacity (MW)
Year
Total Installed Capacity (MW) Assuming Existing Generation Assets and Planned Plant Life
Peak Demand: IMO Medium Growth Forecast (MW)
Peak Demand + 15% Reserve (MW)

Pembina Project

Four Questions:

- Potential contribution from end-use efficiency, cogeneration, fuel switching and demand response
- Potential contribution from low-impact renewables (wind, hydro, biomass)
- Supply options for remaining grid demand
- Policy framework for implementation

CIMS Analysis

- Developed by EMRG at Simon Fraser University
- Designed for the purpose of testing the macro and micro impact of energy policy options

CIMS Analysis

- Incorporates most detailed information available on current end-use technologies on a jurisdictional basis
- Considers cost and performance commercially available high efficiency technologies

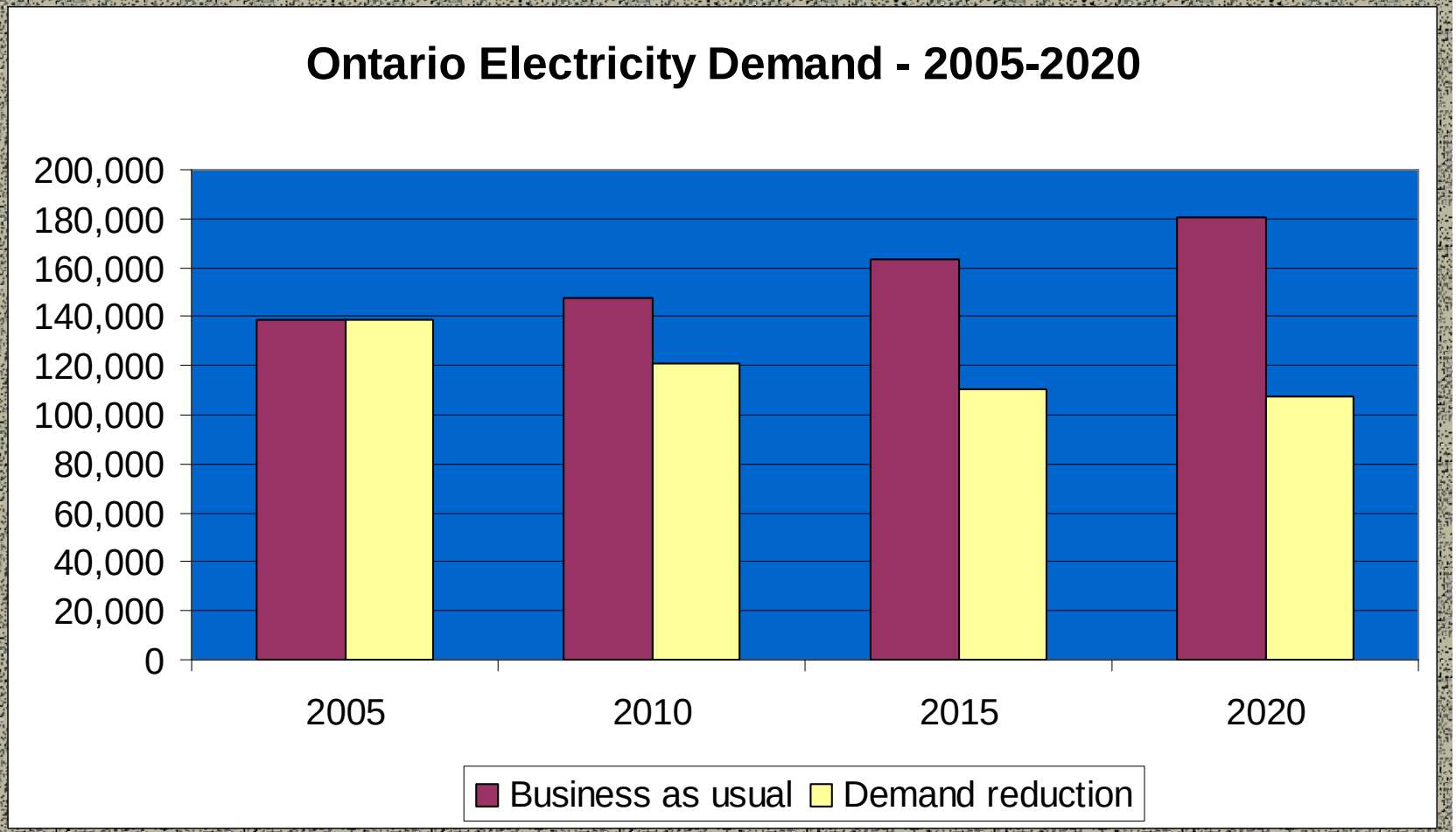
CIMS Analysis

- CIMS used to project impacts of three types of policies against 'business as usual' projected demand 2005-2020
  - Remove constraints on cogeneration
  - Provide financial incentives for purchase of efficient technologies
  - Provide innovative financing measures to reduce payback time on efficiency investments

CIMS 'Business as Usual' Outlook

- Projects grid demand of 180,000 GWh by 2020
- Similar to IMO and ECSTF projections
- Uses Stats Can and NRCan energy price forecasts

CIMS Results



CIMS Results

- Reduction of 2020 demand to 107,000 GWh
- 73,500 GWh/Year reduction against ‘business as usual’
- 41% reduction in demand against ‘business as usual’

CIMS Results

- Results reflect:
  - Significant adoption of most efficient currently available technologies in all sectors by 2010

CIMS Results

- Largest savings from:
  - Commercial/institutional building shell and HVAC, and lighting improvements
  - Elimination of electric hot water heating in residential and commercial/institutional sectors
- Provision of innovative financing to reduce perceived payback period for efficiency investments has largest impact on behaviour

Impact on Natural Gas Consumption

- Increase of 130 PJ in gas consumption by 2020 attributable to fuel switching and increased cogeneration
- 12% higher than business as usual projection

Societal Costs and Benefits of Efficiency Gains

- Total investment $18.2 billion over 2005-2020
- 96% recovered through energy savings
- Net savings for industrial and institutional/commercial sectors
- Net costs for residential sector of $6 per person per year
- Does not take into account health and environmental co-benefits of avoided generation

Peak Capacity Requirement Reduction

- Capacity requirement reduction from CIMS projections of efficiency, cogeneration and fuel switching (using IMO load factors) = 12,300 MW by 2020.

Additional Peak Reductions from Demand Response

- Potential shift of 10% Peak through Demand Response

  (Navigant consulting study for IMO)

Peak Load Shaving through Demonstration Projects

- 1000MW solar roof program to reduce peak demand 750MW.
- Addresses summer peaks

Peak Demand Reduction Summary

	2010 Peak (MW)		2015 Peak (MW)		2020 Peak (MW)	
	Winter	Summer	Winter	Summer	Winter	Summer
IMO Forecast for Peak Demand	26,000	27,800	26,500	28,700	28,000	30,000
Peak Demand Reduction from Energy Efficiency, Fuel Switching, and Cogeneration	(4,500)	(4,500)	(8,900)	(8,900)	(12,300)	(12,300)
Demand Response Measures	(2,330)	(2,330)	(1,980)	(1,980)	(1,770)	(1,770)
On-Site Generation		(250)		(500)		(750)
Net Grid Peak Demand	19,170	20,700	15,620	17,320	13,930	15,180

Renewable Supply Options

- Hydro
  - Current Capacity 7600MW
  - OWA indicates additional potential for 1200-4000MW
  - Assume 2000MW new capacity including 600MW Niagara expansion
  - Total 9600MW

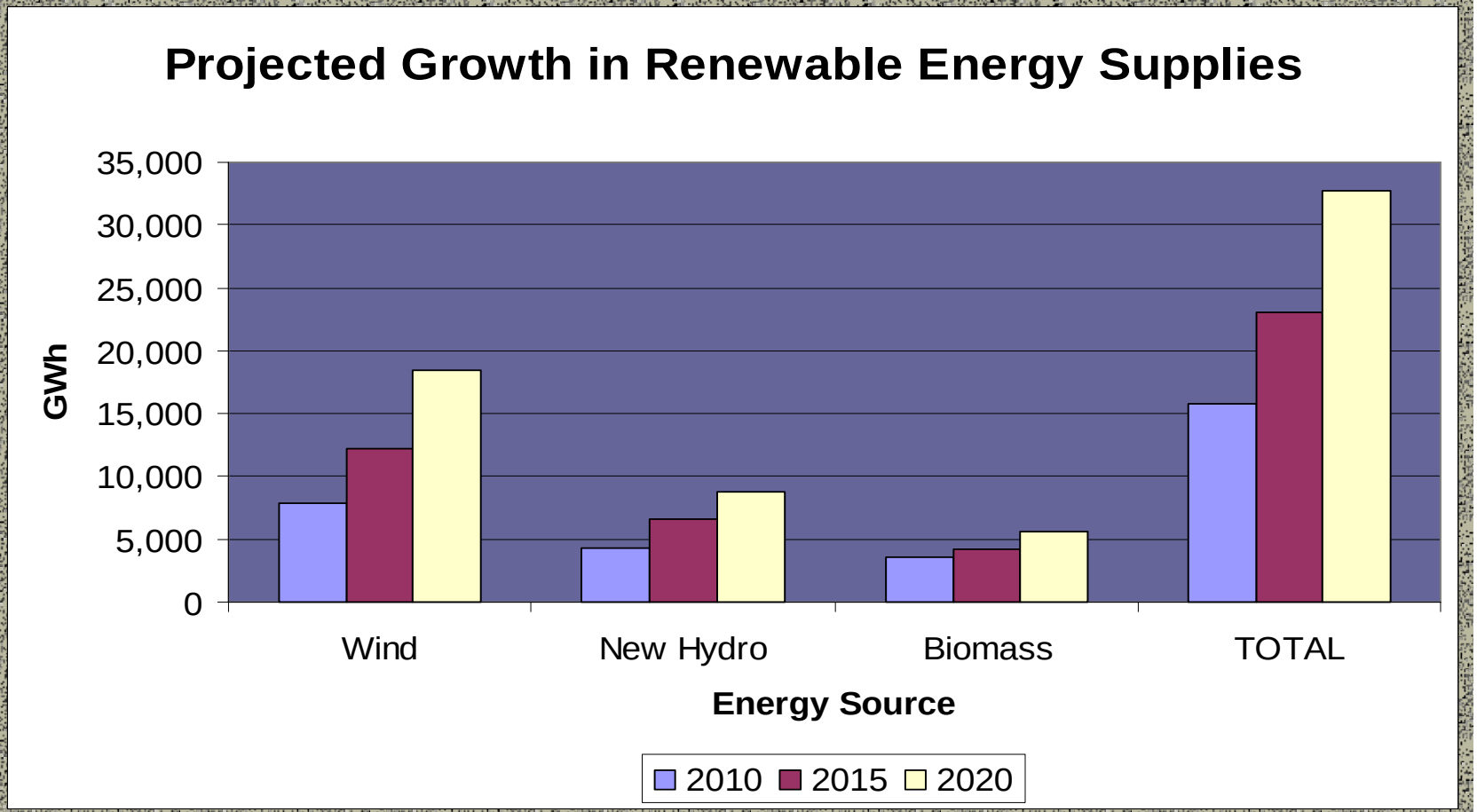
Renewable Supply Options

- Wind
  - OWPTF estimate of 3000 to 7000MW excluding offshore
  - Good match between wind generation and peak demand and hydro storage
  - Assumed 7000MW capacity by 2020 (on and off-shore)

Renewable Supply Options

- Biomass
  - Landfill gas and biogas generation and combustion
  - Assumed 800MW

Renewables Summary



Renewables Summary

- 9,800 MW installed renewable capacity, contributing 4,600MW to peak supply by 2020
- Remaining grid requirement by 2020: 25,633GWh/4500MW Capacity
- Less than full replacement of current coal generation (36,946GWh in 2003)

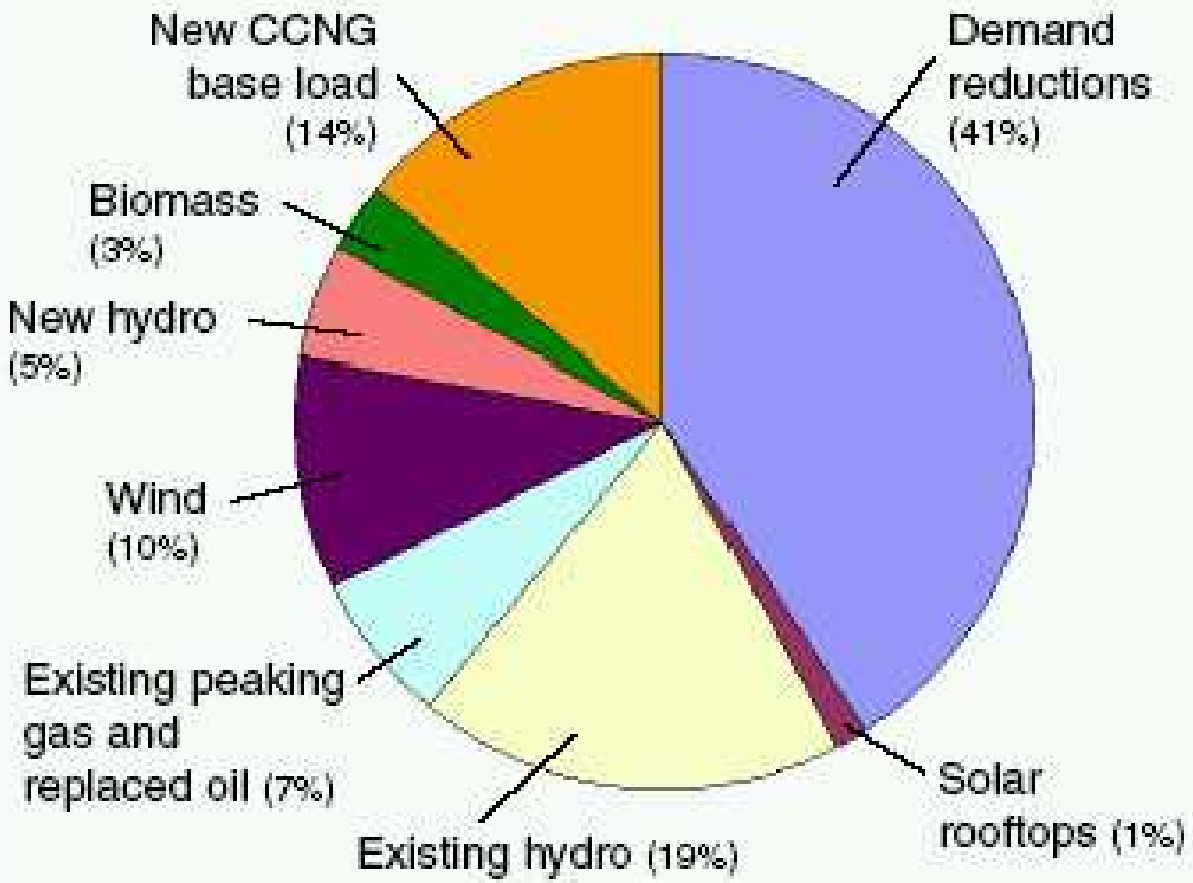
Remaining Base load Options

- Imports
  - Quebec/Manitoba Hydro
  - Political, environmental and social risks
- Nuclear
  - High and unpredictable capital costs
  - Reliability, safety, waste management and life-cycle environmental concerns
- 'Clean' combustion
  - Integrated Gasification Combined Cycle
    - Reduced smog and acid rain precursors and heavy metals, but not GHGs relative to conventional coal

Remaining Base load Options

- Combined Cycle Natural Gas
  - Highest efficiency
  - Large reductions in smog and acid rain precursors, heavy metals and GHGs
  - May imply need to expand pipeline capacity
  - Long-term supply issues
- Transitional fuel to full reliance on renewables

Meeting 2020 Demand:
A new power recipe for Ontario



% of GWh supplied by source

Policy Implications – Efficiency

- Minimum efficiency standards and building codes raised to 2004 high efficiency levels by 2010/2012
- Labeling of efficient technologies
- Planning Act amendments

Policy Implications – Efficiency

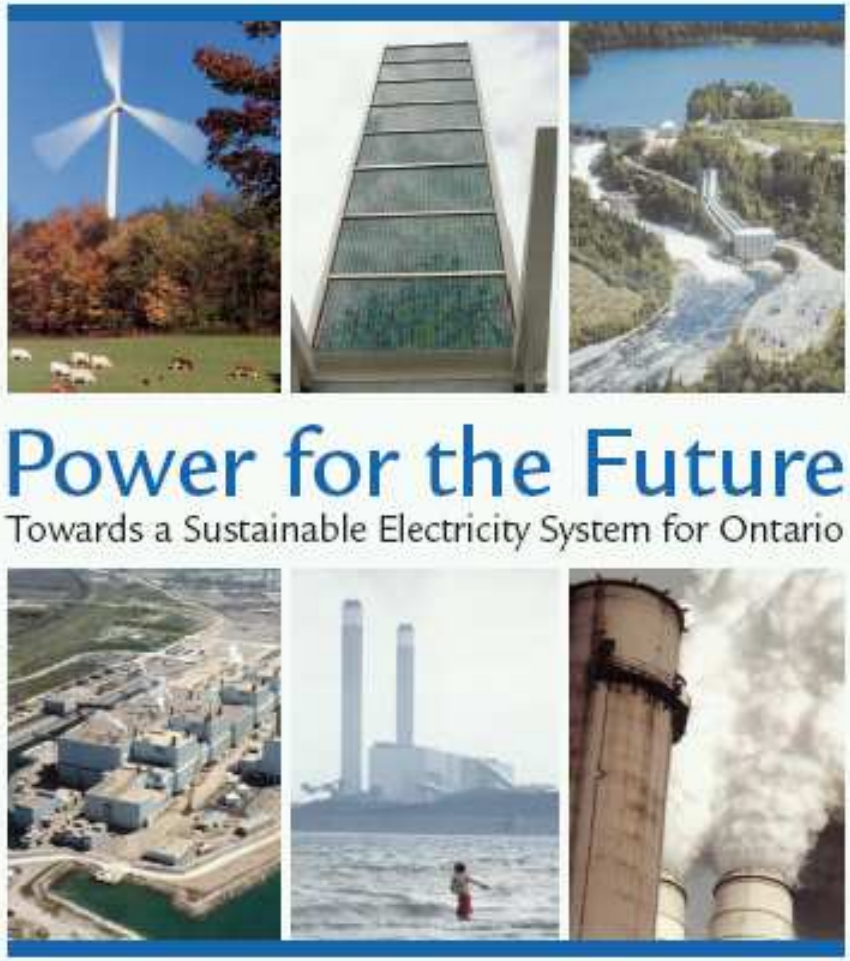
- Ontario Energy Board mandate and DSM incentive mechanism for all electrical utilities
  - Now in place
- Mandate to include low income program delivery

Policy Implications – Efficiency

- Establishment of Ontario Sustainable Energy Authority
  - Power Authority should have been division of sustainable energy authority

Policy Implications – Renewables/Supply

- RPS for wind, hydro and biomass
  - May include feed-in tariff
- Improved integration of dispatchable and intermittent power sources
- Analysis of renewable potential
- Land-use guidelines re: wind
- Long-term supply contracts for needed base load



Power for the Future

Towards a Sustainable Electricity System for Ontario

Pembina Institute
for Appropriate Development

Canadian Environmental Law Association

www.pembina.org

POLLUTION PROBE
CLEAN AIR. CLEAN WATER.

Green Power
Provincial/Territorial Targets and Policies

Information Updated: September 2005

Nova Scotia — RPS for 5 per cent of total generation must be renewables by 2010.

- Sources include: small-scale hydroelectricity, wind power and biomass fuels
- Sources must be built after 2001 as per Electricity Act
- In past 16 months — 100 MW renewable energy contracts awarded

New Brunswick — RPS for additional 10 per cent of total consumption by 2016.

- Most common sources include: wind, biomass, hydro and landfill gases
- Power purchase agreement signed for 20 MW of wind
- By 2016 — up to 400 MW of wind energy to be purchased by NB Power.
- Summer 2005 — NB Power to issue call for EOI for wind

Prince Edward Island — RPS for 15 per cent of total generation by 2010. Exploring 100 per cent by 2015.

- December 2004 — Renewable Energy Act received royal assent that includes an RPS and guaranteed feed-in tariff for community, wind cooperative and large systems
- RE Act requires utilities to acquire at least 15 per cent of their electrical energy from renewables by 2010
- Sources include wind, solar, hydro and biomass
- February 2005 — EOI for oil seed extraction and biodiesel manufacturing plant
- Summer 2005 — 30 MW wind farm proposed (based on a government and co-op ownership model). Responses received for RFP for project design services and RFI for project financing.
- Spring 2005 — announced intention to develop a wind-hydrogen village demonstration project

Newfoundland — RFP for Wind Power Development Strategy.

- February 8, 2005 — RFP issued. Proposals to provide recommendations to government on the development of a Wind Power Development Strategy
- Summer 2005 – Climate Change Action Plan 2005 released. A comprehensive energy plan consultation document to be released in 2005

Québec — Targets for 2,000 MW of wind by 2014 and 100 MW of biomass by 2008.

- Contracts signed for 39 MW of biomass by 2007
- Contracts signed for 990 MW of wind
- June 2005 — Bid selected to purchase 8.1 MW of biomass
- June 2005 — Hydro-Québec to issue a call for tenders for 2,000 MW of wind
- By 2013 — 3,500 MW expected from wind power

Ontario — RPS for 5 per cent (1,350 MW) by 2007 and 10 per cent (2,700 MW) by 2010 of total generation to be new renewables.

- June 2004 — RFP for 300 MW released. Projects announced for 395 MW
- April 2005 — RFP for 1,000 MW of 20 to 200 MW generation facilities
- July 2005 — RFP for 200 MW generation under 20 MW
- RFP sources include wind, water, solar, biomass and landfill gas

Manitoba — Target for 1,000 MW of wind by 2014.

- October 2004 — wind power strategy developed
- By end of 2005 — 99 MW wind project to be completed. 12 test wind turbines are now operational

Saskatchewan — Target for 150 MW of wind by 2005. 100 per cent of new generation until 2010 to be operations that do not add to GHG emissions.

- Projects include: wind (major component), energy conservation, small hydro, distributed generation (includes cogeneration), and Environmentally Preferred Power Program (low environmental impact generation such as, flare gas and heat recovery systems)
- May 2005 — 32 MW RFP released
- December 2005 — 150 MW wind power project to be completed (under construction)

Alberta — Target for 3.5 per cent of total generation by 2008.

- 3.5 per cent renewables target represents about 560 MW of new capacity
- January 2005 — 90 per cent of electricity used in provincial government operations must be from renewables and alternative power
- Currently, Canada's leader in wind power with 275.4 MW installed capacity

British Columbia — 50 per cent of new generation to be clean energy by 2012.

- Voluntary goal for electricity distributors
- Sources include wind, solar, ocean, biomass, hydro, geothermal, fuel cells, efficiency measures and cogeneration
- April 2005 — release of Alternative Energy and Power Technology: A Strategy for BC

Territories

Yukon: Yukon Development Corporation 2004 Progress Report includes 1 MW wind increase by 2006

Northwest Territories: NWT Energy Strategy includes 10 per cent of total energy supply by 2010, 25 per cent by 2025 from renewable energy sources (excluding industrial energy supply)

Nunavut: Energy Action Plan includes increase of renewable energy by 2008 in 1 or 2 community projects. RFP was issued in 2003 for 1.3 MW, however, there is no implementation date

A Green Power Vision and Strategy for Canada

towards a sustainable electricity future for Canada

A Green Power Vision and Strategy for Canada is the result of a series of five workshops held across the country by Pollution Probe and Summerhill Group. The workshop series, which was held between October 2003 and April 2004, assessed the potential for Green Power sources, such as wind, solar, biomass, geothermal, tidal and wave, to meet Canada's electricity needs. The series actively engaged more than 300 experts in Green Power, electricity generation and policy development and included representatives from government agencies, utilities, the private sector, academia and non-profit organizations, as well as from countries that are world leaders in Green Power development.

Visit the Pollution Probe website at **www.pollutionprobe.org/whatwedo/Energy.htm** to view the presentations from the workshop series, along with the following background documents:

Report of the Green Power in Canada Workshop Series (2004)
Primer on the Technologies of Renewable Energy (2003)
Promoting Green Power in Canada — Green Power Policies: A Look Across Borders (2002)

For further information, contact:

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Summerhill Group
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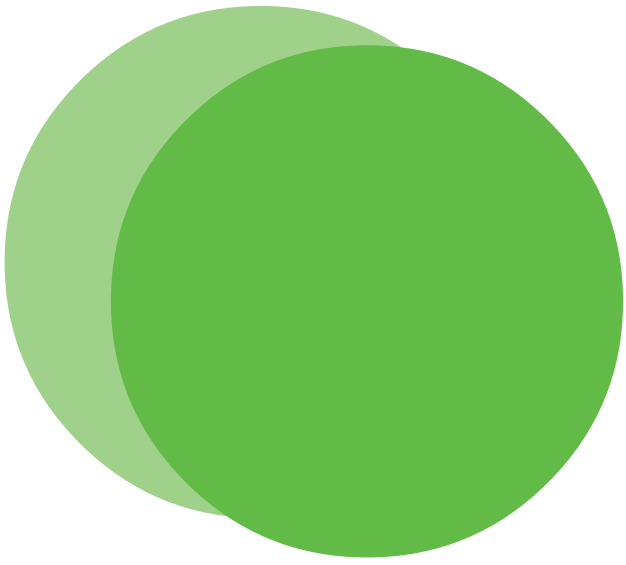
A long-term Vision and Strategy is needed to guide and accelerate the development of Green Power in Canada. The Vision must be shared among all jurisdictions and have broad stakeholder and public support. Strategies with targets and timelines are essential to implementing the Vision as has been demonstrated in countries that are world leaders in Green Power development. Canada has the technology and resource potential to join these world leaders and reap the multiple benefits that Green Power offers.

MAIN MESSAGES

1. Green Power is not a niche market — it can become a significant source of clean electricity across Canada. It has the potential to supply half of Canada's current annual electricity generation through concerted action over the next few decades. By moving aggressively on Green Power development now, Canada can become a full participant in the growing world market for cleaner energy technologies.

2. Green Power is essential to Canada's long-term response to the challenge of climate change. It also reduces smog and other forms of pollution that are linked to respiratory problems, hospitalizations and deaths.



BENEFITS

air pollution reduction
climate change mitigation
job creation
clean development mechanisms projects
rural development
green power
clean energy exports
price hedging
clean technology exports
energy security
electric power grid stability

INTRODUCTION

Electricity generation from wind, small hydro, solar, biomass and geothermal sources, once considered a niche market, is now moving into the mainstream. Ministers and government representatives from 154 countries at the June 2004 International Conference for Renewable Energies in Bonn, Germany, recognized the considerable benefits of Green Power. They committed to substantially increase, with a sense of urgency, the global share of renewable energy in the total energy supply. At the same time as the global community has been increasing its experience in the development of Green Power technologies, there has been a growing realization that now is the time for Canada to take advantage of its significant Green Power potential — to address the need for cleaner electricity and to serve both domestic and international markets.

From October 2003 to April 2004, more than 300 Green Power experts from government agencies, utilities, the private sector, academia, NGOs and several countries were actively engaged in the Green Power Workshop Series. They assessed the potential for Green Power to meet Canada's electricity needs and proposed strategies for achieving that potential.

A Green Power Vision and Strategy for Canada is the result of the workshop series. The Vision and Strategy, along with a leading-edge report on Green Power in Canada, reflects Pollution Probe's and Summerhill Group's work to turn the vast amount of information and advice received into a concise and progressive forward path.

Definition of Green Power

In this document, "Green Power" refers to sources of low-impact renewable energy that meet the criteria set by the Environmental Choice Program, currently the most commonly used definition in Canada. The Environmental Choice Program gives EcoLogo recognition to Alternative Source Electricity Generation from naturally occurring sources (such as the wind and sun) and from sources and technologies that have small environmental impacts (such as less intrusive hydro and certain biomass combustion). The criteria can be found at www.environmentalchoice.com/index.cfm?fuseaction=main.dspCompany.cfm&group=5.

There is scope for reviewing and revising these criteria to more specifically target electricity generation from Green Power sources. This Vision and Strategy does not preclude such a revision.

OUR VISION

Towards a Sustainable Electricity Future for Canada

The Vision *Towards a Sustainable Electricity Future for Canada* is an integral part of a larger Canadian vision that includes reduced air pollution and climate change impacts, improved human health, increased energy security, job creation and positioning Canadian firms among the world leaders in the manufacturing and exporting of innovative technologies.

While this Vision and Strategy focuses on Green Power, it recognizes that important contributions must be made by energy efficiency and conservation measures. There is also a role for cleaner electricity from other sources, such as ecologically sustainable larger-scale hydro and improved traditional technologies. Policy recommendations for these sources and measures are not included in this document as they were beyond the scope of the workshop series.

The following list shows sustainable electricity future options in order of priority. It highlights the importance of Green Power to the future electricity mix.

1. Energy efficiency and conservation;
2. Green Power that meets the criteria for EcoLogo certification;
3. Ecologically sustainable larger-scale hydro and other renewables;
4. Combined heat and power using natural gas; and
5. The cleanest and safest technologies among the remaining options.

TARGETS AND TIMELINES

Setting Green Power targets requires looking beyond present barriers and assessing the long-term potential for mature and emerging Green Power technologies to meet future electricity demand. Using the best information available for each technology, a portfolio of options has been used to propose a total Green Power generation target for the year 2025.

Aggressive targets for Green Power development in Canada are possible given the total generation potential available to the country.

Green Power initiatives underway or announced by federal and provincial governments could represent seven per cent of electricity generation in Canada by 2010. The total technical potential of Green Power for the long-term is much higher when estimates are included for all of Canada's Green Power resources and when expected improvements in technology are considered. The total potential is at least 340 TWh, or more than half of the current annual electricity generated in Canada (~600 TWh).

The following table contains a potential Green Power portfolio for 2025, showing the contribution by various Green Power technologies. The capacity factor is the percentage of actual electricity output expected in a given time period (generation) compared to the maximum possible if the source ran full time at its peak potential (capacity). Generation (TWh) has been used to set the targets for Canada as it shows the actual electricity that would be produced from Green Power sources.

The mix of Green Power technologies used to meet the target in 2025 will likely differ from the portfolio presented as some technologies could generate less than expected while others could generate more. Targets have also been suggested for 2010, 2015 and 2020. The focus of the Vision and Strategy is on the total electricity generated by Green Power for each target year.

Potential Green Power Portfolio for 2025

TECHNOLOGY	CAPACITY (MW)	CAPACITY FACTOR (PER CENT)	ELECTRICITY GENERATION (TWh)
Wind — onshore	21,000	30	55
Wind — offshore	3,400	40	12
Small hydro	10,000	50	44
Biomass	4,500	80	32
Geothermal	500	95	4
Solar	1,000	14	1
Wave	500	30	1
Tidal	500	30	1
TOTAL	**41,400**		**150**

The target for 2025 is 150 TWh of electricity generated by Green Power.

Green Power Targets for Canada

45–60 TWh of green power by 2010.

90 TWh of green power by 2015.

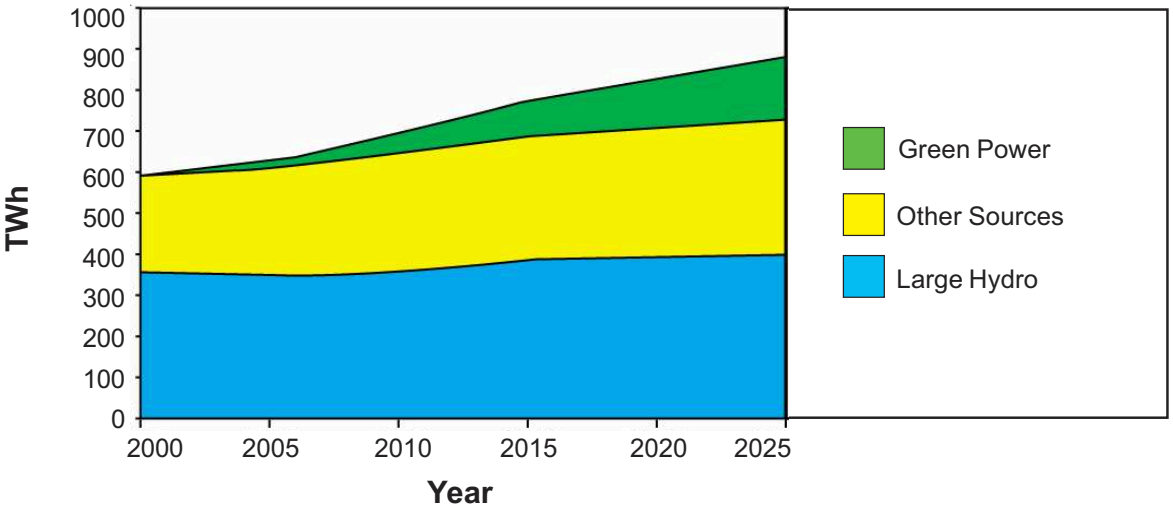
120 TWh of green power by 2020.

150 TWh of green power by 2025.

The impacts of achieving the Green Power targets are illustrated in the following graphs. The targets are shown relative to the total business-as-usual (BAU) projections for electricity generation of the National Energy Board (NEB 2003). The graphs have been modified to include Green Power generation as the targets are achieved.

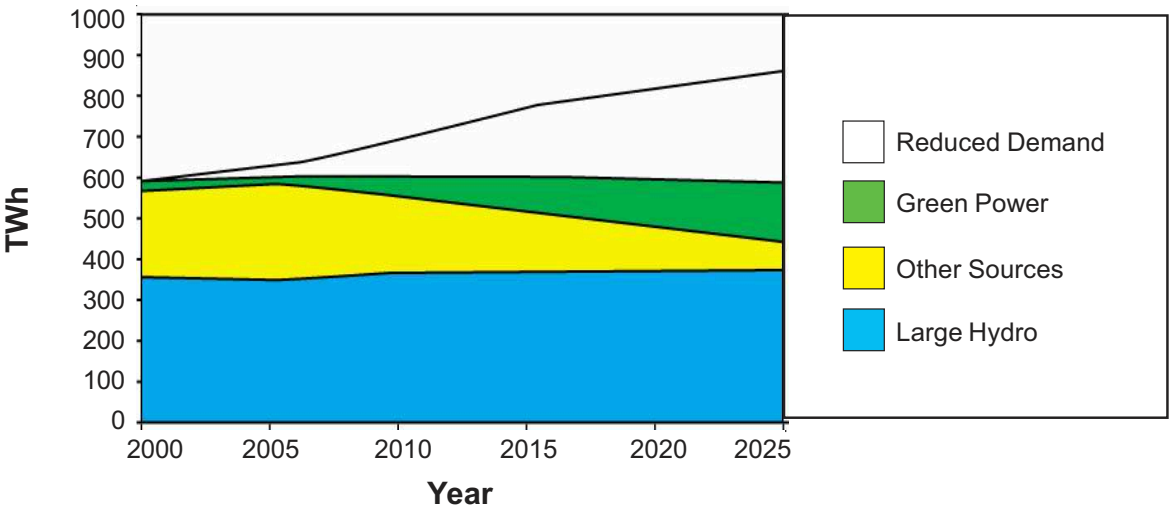
Under the Business-As-Usual Scenario, Green Power represents 17 per cent of the electricity mix by 2025. As the total demand for electricity increases, there is an increase in generation by Other Sources (e.g., fossil fuel and nuclear power).

Business-As-Usual Scenario



Under the Stable Demand Scenario, total domestic electricity demand is stabilized at the current level (600 TWh). Green Power represents 25 per cent of the mix by 2025 and there is a decrease in generation by Other Sources. To achieve this scenario, electricity demand would have to decrease 31 per cent by 2025 relative to the National Energy Board's projection for business as usual.

Stable Demand Scenario



STRATEGY

To develop Green Power to its full potential in Canada, concerted action will be required on several fronts. Three priority areas for action are identified below, complemented by seven additional areas that need to be addressed to remove the barriers to, and achieve the potential for, Green Power development and deployment.

The following strategies and recommendations do not allocate responsibilities by jurisdiction. It is expected that federal, provincial, territorial and municipal governments will select portfolios of action that take into account their specific resource potentials, economic circumstances and the value of using combinations of initiatives. They should all develop roadmaps outlining strategies, targets and timelines and begin implementation so that by 2010 Canada has not only achieved the first shared national target, but has put in place the policies and incentives to achieve later targets.

All jurisdictions and sectors need to work together in a spirit of cooperation in order to fully implement the Vision and Strategy.

Priority 1 — Leveling the Playing Field

Billions of dollars have been invested in fossil fuel technologies and nuclear power to ensure that Canadians have reliable and low-cost supplies of electricity. It is time to invest in Green Power sufficiently over the long-term to develop viable domestic and export markets for Green Power and related technologies.

Recommendations:

- ***Renewable Portfolio Standards, Targets or Equivalent Policy Commitments***, such as feed-in tariffs, should be established by provincial, territorial and key municipal governments. These should include tailored targets for each jurisdiction and specified timeframes for the development of Green Power technologies. The national targets can be achieved through a combination of regional strategies supported by federal incentives.

- ***A Green Power Production Incentive*** (GPPI) should be established by the federal government and complemented by the provinces and territories. It should support the development of market-ready Green Power technologies that require additional support. The existing federal Wind Power Production Incentive (WPPI) should be substantially increased and either become part of or run parallel to the GPPI.

Alberta, British Columbia, New Brunswick, Nova Scotia, Ontario and PEI have implemented, or are working on, voluntary and mandatory Renewable Portfolio Standards.

- ***Green Power Procurement***. Federal, provincial, territorial and municipal governments should lead by example by setting aggressive targets for Green Power procurement for their own use. All new public buildings should be built to strict energy efficiency standards and should obtain a set percentage of their energy needs from Green Power generation. A program should be established to encourage the private sector and institutions to procure Green Power.

- ***A Renewable Energy Certificate System*** should be established to support the implementation of Renewable Portfolio Standards. The system should be voluntary and flexible. Inter-provincial cooperation could reduce overall costs and support an enhanced national target for Green Power development. Provinces and territories could require that a share of their Green Power targets be generated by local sources.

- ***A System Benefits Charge*** (SBC), which is a small surcharge added to consumers' electricity bills, could be used to finance specific Green Power policy initiatives. There would be a cost to consumers, which would be offset by improved environmental quality and human health.

Alberta has required that 90 per cent of the electricity used for public buildings be from Green Power sources by 2005.

Priority 2 — Supporting Innovative Technologies

There is an opportunity for Canada to be among the world leaders in the development of Green Power technologies. For example, Canada has tremendous resources that can be tapped for biomass and ocean-based power. Innovative technologies designed to harness this power could be marketed worldwide. Capitalizing on these opportunities will require leadership, innovation and focused support.

Recommendations:

- ***A Comprehensive Strategy*** should be developed for the research, development, demonstration and commercialization of emerging Green Power technologies by the federal government working in cooperation with the provinces, territories and industry. Existing R&D funding programs should be refocused or enhanced to support implementation of the strategy, and gaps should be filled through new initiatives.

Québec has set targets for 1,000 MW of wind and 100 MW of biomass by 2010.

- ***Centres of Excellence*** for various Green Power technologies should be established throughout Canada. Objectives for each Centre should be set in keeping with regional resource profiles.

- ***Sustainable Development Technology Canada*** (SDTC) has had its role strengthened to serve as a catalyst for the demonstration and pre-commercialization of sustainable development technologies, including Green Power. The provinces should partner with SDTC or establish similar mechanisms to develop innovative Green Power technologies to serve their regions.

- ***Technology Road Maps***, such as those being developed by the SDTC, should be prepared to help the private sector select and develop the best technology options to meet future technical, environmental and market needs.

Ontario has proposed a Green Power target of 10 per cent of its total energy capacity by 2010.

Priority 3 — Engaging Canadians in Achieving the Vision

To achieve the Vision for Green Power development in Canada, it will be essential to gain widespread public support for national and provincial/territorial targets. Municipalities will also be important focal points for this activity.

Recommendations:

- ***Community Engagement*** should become a standard component of local Green Power planning by governments and industry. In areas with substantial Green Power resources, communities should be made aware of the resources in their regions and how Green Power development can offer economic benefits and contribute to the national Vision. Specific sectors should be informed of the role they can play in the development of Green Power (e.g., farmers who can lease their land for wind turbines).

- ***Community-based Projects*** should be encouraged through incentives and by streamlining the regulatory process to support public investment in Green Power.

- ***The Market Incentive Program*** should be expanded to increase funding support for the sale of electricity from emerging Green Power sources and should be extended beyond 2006 to support longer term contracts for Green Power. The provinces and territories should be engaged to develop a broader-based consumer green energy rebate program.

- ***A Comprehensive Public Education and Outreach Strategy*** should be developed to inform Canadians broadly about the Vision for a sustainable electricity future for Canada and to promote awareness of the benefits this future promises. Resources to support implementation of the Vision should be developed for use by community leaders, educators, NGOs and the private sector.

Windshare is a project developed by the Toronto Renewable Energy Co-operative and jointly owned with Toronto-Hydro, in which more than 400 members have invested in a wind turbine located in Toronto.

Supporting Strategies

Work will be needed in many areas to ensure that Green Power technologies become mainstream. The following recommendations address key requirements for these new technologies to successfully gain market share.

Accessing the Power Grid

A robust Green Power industry cannot develop without open and fair access to the power grid. The best locations for Green Power sources, such as wind, small hydro and geothermal, may be located far from existing transmission lines. The grid will have to be extended to appropriate areas with increased capacity.

Saskatchewan has committed to meeting its needs for incremental power to 2010 through Green Power.

Recommendations:

- ***Expansion of power grids*** to support implementation of the Green Power targets should include identification of areas that offer viable green power resources, assessment of transmission grid needs, and environmental assessments of the projects, with full consideration given to the environmental benefits of Green Power.
- ***Transmission planning*** should proactively support the expansion of Green Power as the aging grid is rebuilt.
- ***The cost to extend transmission lines*** should be shared by the overall customer base or co-funded by governments in public-private partnerships, once developers have paid a reasonable price to connect to the grid.

PEI is proceeding with a Renewable Portfolio Standard of 15 per cent by 2010 and is considering 100 per cent by 2015.

- ***Efforts towards grid integration and coordination*** should begin now among provinces and territories to facilitate interconnection and the optimal development and sharing of Green Power resources across Canada.

Mapping Green Power Resources

To fully develop Canada's Green Power resources, it is essential to know where they are located. Mapping of Green Power resources in Canada is crucial for strategic policy support and the development of Green Power industries. While some work has been done (e.g., the federal Wind Atlas that is under development), there is an immediate need to identify the location and potential of wind, solar, hydro, tidal, biomass, geothermal and wave resources in Canada.

BC Hydro has developed a comprehensive map of Green Power resources in British Columbia.

Recommendations:

- ***Resource maps*** should be developed for all Green Power resources across Canada through the cooperation of federal and provincial/territorial government agencies. The resource maps should be available to the private sector and the public.

- ***Assessment of backup for intermittency*** should be part of the mapping of Green Power resources. The assessment should include the use of multiple locations, potential synergies of various Green Power resources and the existing potential of conventional sources, such as hydro or natural gas, to serve as backup for intermittent Green Power resources.

Establishing Mechanisms for Distributed Generation

Policy frameworks for Green Power generation often overlook distributed generation (i.e., Green Power generation units located close to where the energy is used), in spite of the potential this option offers to reduce demand for central, large-scale electricity generation and to reduce peak demand for grid electricity (i.e., peak-shaving). Distributed Green Power generation also offers significant benefits to remote communities.

Recommendations:

- ***Aggressive national and provincial targets*** should be set for solar roofs, supported by capital buy-downs, to facilitate their widespread use (e.g., Germany has a target of 100,000 solar roofs).

- ***Provincial net metering programs*** should be developed to enable proponents of distributed generation to sell power back to the grid.

- ***Green Power generation in remote communities*** should be subsidized to be competitive with other subsidized fuels (e.g., diesel) used in electricity generation.

Streamlining Zoning, Planning and Permit Requirements

As several Green Power technologies are relatively new to Canada's electricity mix, municipal and regional planners need guidance to deal with the special needs of Green Power development. In particular, assistance is needed to address the permitting bottlenecks that prevent rapid deployment of Green Power technologies.

Recommendations:

- ***Planning and permitting practices should reflect official government targets***. Provincial governments should assist municipalities in addressing bottlenecks to Green Power development on both private and Crown land. For example, they should recommend streamlined models for zoning standards and should clarify Crown land use policies. Where possible, the processing of planning applications for Green Power projects should be centralized in one provincial/territorial ministry.

- ***Environmental impact assessments*** for Green Power projects should be tailored to the needs of specific technologies. In addition, streamlined approval processes should be developed for technologies proven to be low-impact. These assessments should be harmonized among jurisdictions so that one process offers federal and provincial/territorial approvals.

Developing Standards to Ensure Quality and Safety

As Canada gears up to introduce new technologies for centralized and decentralized electricity generation, a broad range of standards need to be developed to ensure the most effective deployment of these technologies. The Canadian Standards Association, or comparable agencies, should be engaged to develop and oversee the development of these standards.

Recommendations:

- ***An assessment should be conducted of the standards needed*** to facilitate the timely introduction of a diverse mix of Green Power technologies in Canada.

- ***Standards should be developed*** to ensure that equipment will meet environmental performance requirements and address quality, safety and the ability to withstand Canadian weather conditions. Consideration should be given to adopting international standards that are well-developed and proven.

The Canadian Standards Association is actively developing standards for renewable energy technologies and distributed energy systems.

- ***National interconnection standards for the installation of small distributed generation systems should be developed***, based on the guidelines developed under the Canadian Micropower Connect committee initiative. These standards should be adopted by all provinces and territories once they are approved by the Standards Council of Canada.

Preparing the Labour Force

International experience indicates that a lack of qualified personnel can be a significant barrier to the development of Green Power. In Ontario alone, it is estimated that approximately 2,000 additional engineers and technicians will be needed to achieve recently announced Green Power targets.

Recommendations:

- ***Primary and secondary school curricula*** should include the study of Green Power and energy efficiency to ensure that students learn basic information and are made aware of career opportunities in these fields.

- ***Post-secondary curricula*** should be developed to support the training (and retraining) of skilled staff for the emerging Green Power market. Government and industry should work with universities, colleges and technical institutes to develop curricula.

The Association of Canadian Community Colleges (ACCC) and Natural Resources Canada (NRCan) have teamed up to kickstart a national training program in renewable energy.

- ***Training courses*** should be developed to prepare utility personnel for the special needs of the Green Power market.

Setting Up Green Power Coordinating Bodies

For the Green Power Vision and Strategy to be implemented successfully, it must be built on strong provincial/territorial foundations. Its implementation will require a coordinated effort by governments in all jurisdictions, as well as effective engagement of stakeholders and the public.

Recommendations:

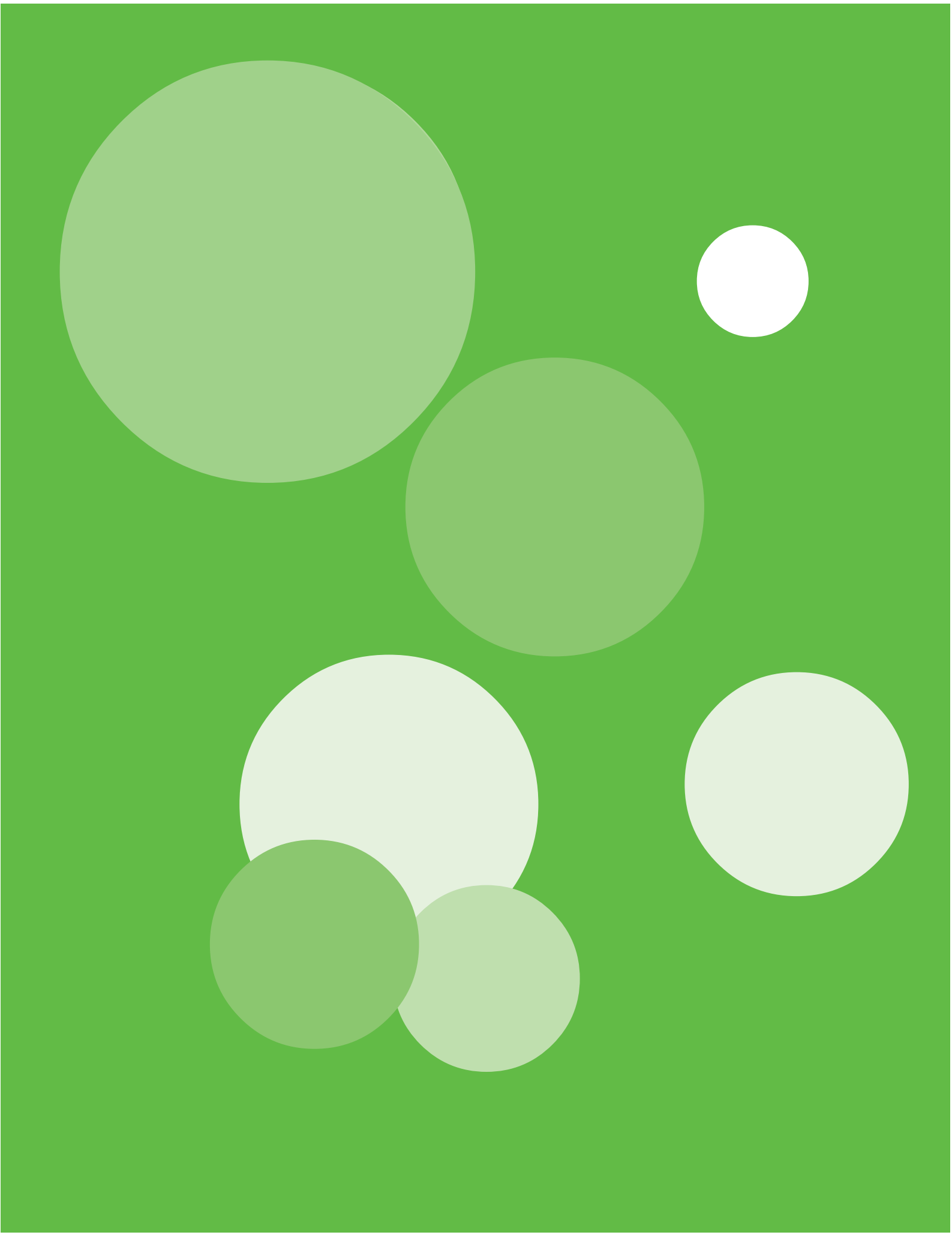
- ***Provincial/territorial Green Power coordinating bodies*** should be created to engage relevant ministries and stakeholders to oversee the establishment and implementation of provincial/territorial plans with targets for Green Power development and deployment.

Alberta's Clean Air Strategic Alliance (CASA) is a working group consisting of government, industry and ENGO representatives. It has formed a sub-group to develop strategies and programs to reach the government-set Green Power target, and to suggest solutions for related issues, such as transmission access.

- ***A new national coordinating body or network*** should be established with representation from relevant federal departments, provinces, territories and key stakeholders. Its mission should be to build support for a shared vision for Green Power, and to oversee the implementation of the Green Power Vision and Strategy in Canada. It should identify new opportunities and engage in problem-solving to overcome barriers.

The Canadian Energy Efficiency Alliance was created in 1995 as a public advocate for energy efficiency in Canada. It monitors and reports on Canada's progress on energy efficiency.

- ***A Canadian Renewable Energy Alliance*** should be established as a multi-stakeholder, non-governmental organization to act as a public advocate for the Vision and Strategy. It should monitor and report publicly on progress toward implementing the Green Power Vision and Strategy for Canada.



A GREEN POWER VISION & STRATEGY

Presentation to the
Ontario Power Authority

October 4, 2005

Mary Pattenden
Director
Climate Change Programme

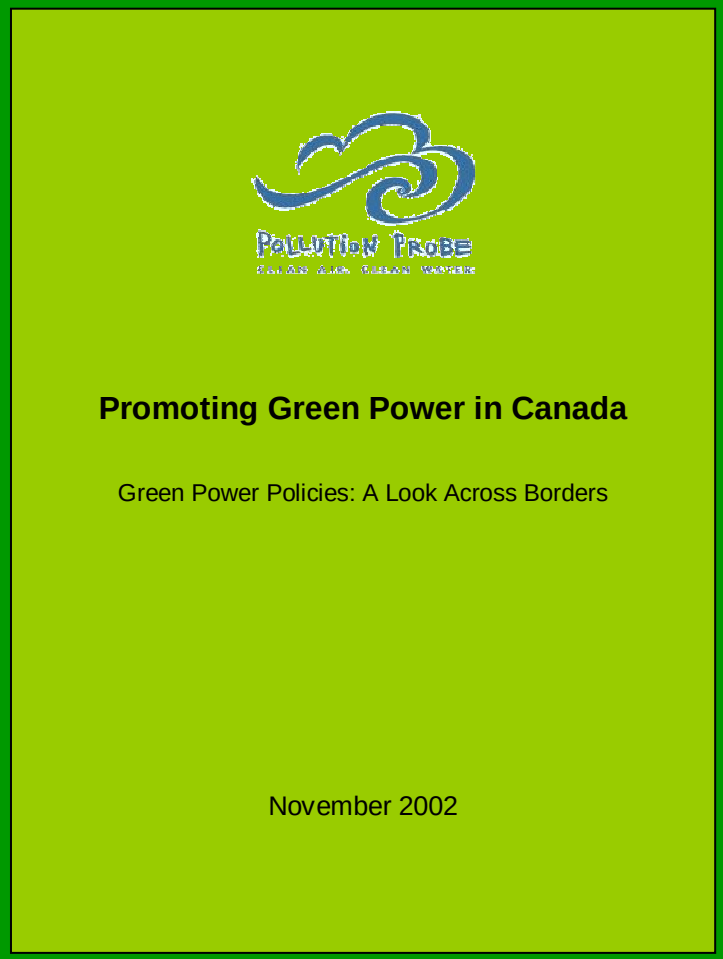
POLLUTION PROBE
CLEAN AIR. CLEAN WATER.

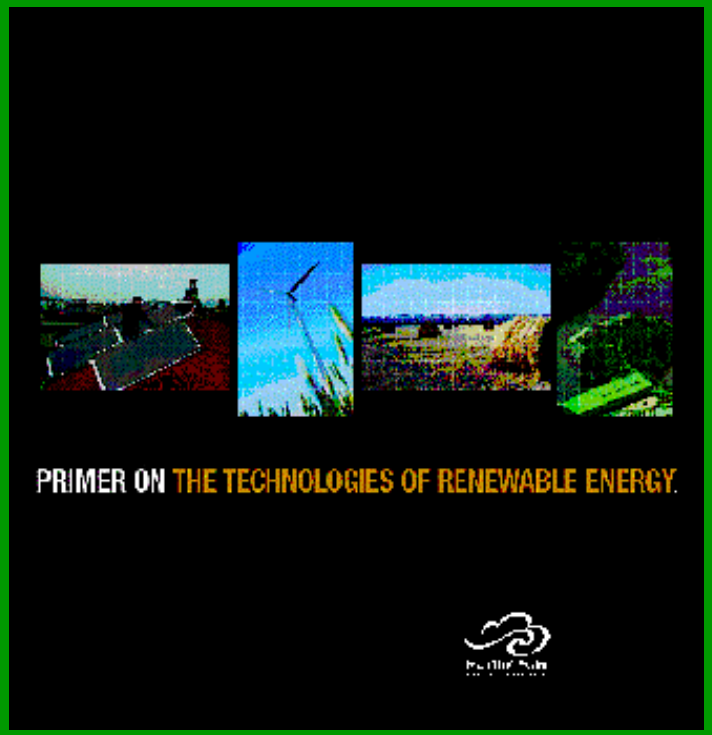
POLLUTION PROBE

Background:

- **Founded in 1969**
- **At the University of Toronto**
- **A non-profit, charitable organization**
- **Supported by 6,000 donors**
- **Mandate: environmental policy development**
- **Work based on research and partnerships**

GREEN POWER ACTIVITIES





GREEN POWER WORKSHOP SERIES

HALIFAX:	**Current Status and Challenges**
MONTREAL:	**Technology Development and Resource Potential**
TORONTO:	**Investments and Markets for Green Power**
CALGARY:	**Policies and Incentives for Green Power Development**
VANCOUVER:	**A Vision and Strategy for Green Power in Canada**

GREEN POWER WORKSHOP SERIES

PARTNERS:

Pollution Probe

Summerhill Group

SPONSORS:

BC Hydro
Canadian Energy Efficiency Alliance
Canadian Standards Association
Clean Air Renewable Energy Coalition
Climate Change Central, Alberta
Commission for Environmental Cooperation
Consulate-General - the Netherlands
Enbridge Inc.
EnCana
Environment Canada
Hydro-Québec
Intersan
JD Irving, Limited
Macleod Dixon
National Round Table on the Environment and the Economy
Natural Resources Canada
New Brunswick Power
Nova Scotia Department of Energy
Nova Scotia Power
Ontario Power Generation Inc.
Québec ministère de l'Environnement
Shell Canada Limited
Suncor Energy
Sustainable Development Technology Canada
Vision Quest Windelectric Inc.
Western Economic Diversification
Western GeoPower Corp.

GREEN POWER: STATUS IN CANADA

TECHNOLOGY	INSTALLED CAPACITY (MW)	TECHNICAL POTENTIAL (MW)
Small hydro	2,000	11,000
Biomass	1,713	7,000
Onshore wind	590	40,000
Tidal energy	20	3,000
Solar PV	10	70,000
Offshore wind	0	2,500
Geothermal	0	3,000
Wave energy	0	10,000

GREEN POWER MARKET READINESS

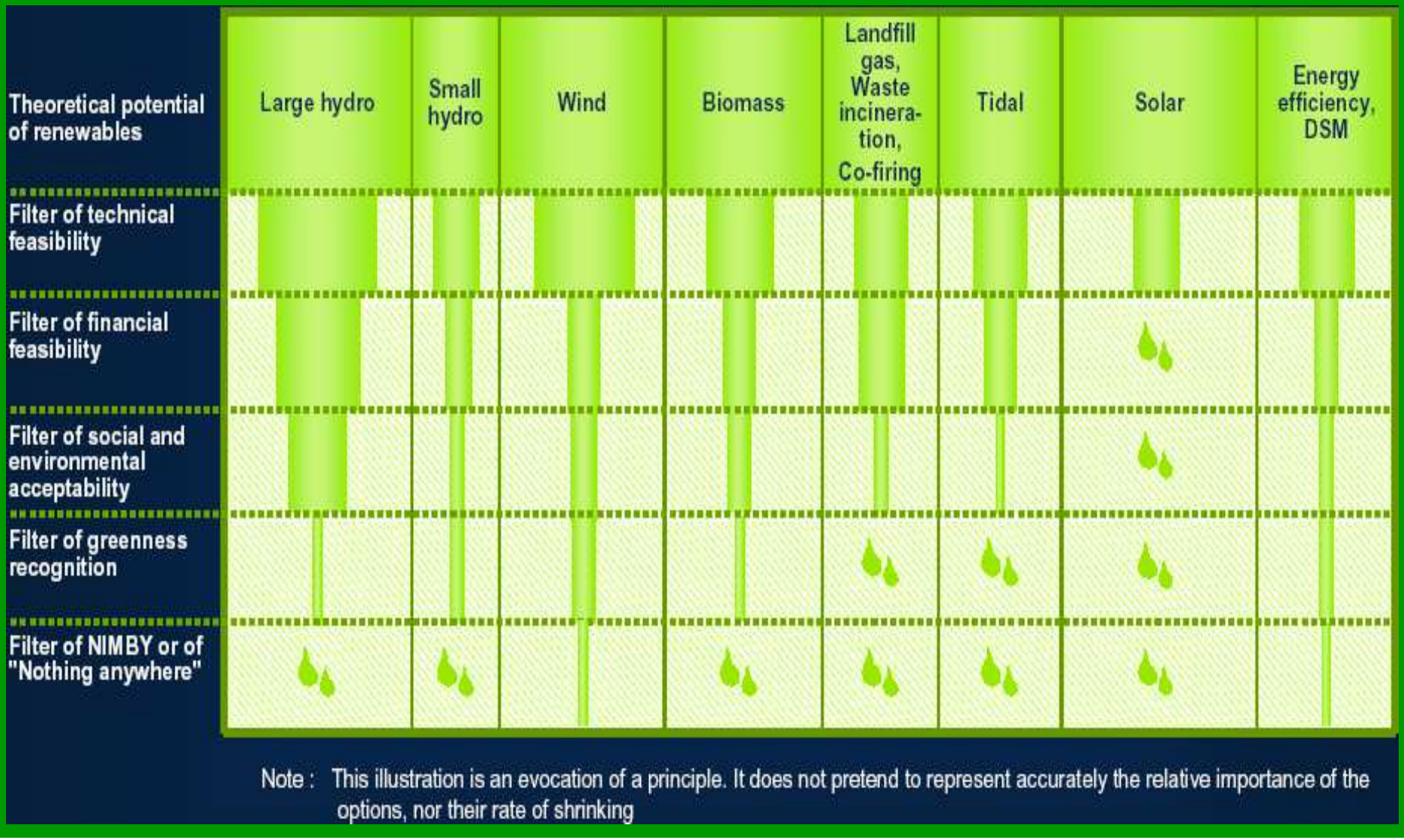
TECHNOLOGY	READINESS	CANADIAN PRODUCTS	COST EFFECTIVE WITHOUT INCENTIVES
Small Hydro	Yes	Yes	Now
Wind	Yes	Parts Only	By 2010
Photovoltaics	No (2010)	Yes	By 2025
Biomass (Forest Waste)	Yes	Yes	Now (CHP)
Biodiesel	Yes	Yes	No
Landfill Gas	Yes	Yes	Site Dependent
Fuel Cells	No	Yes	No
Power Electronics	Yes	Yes	Costs are falling

Source: Modified from Filion. 2003.

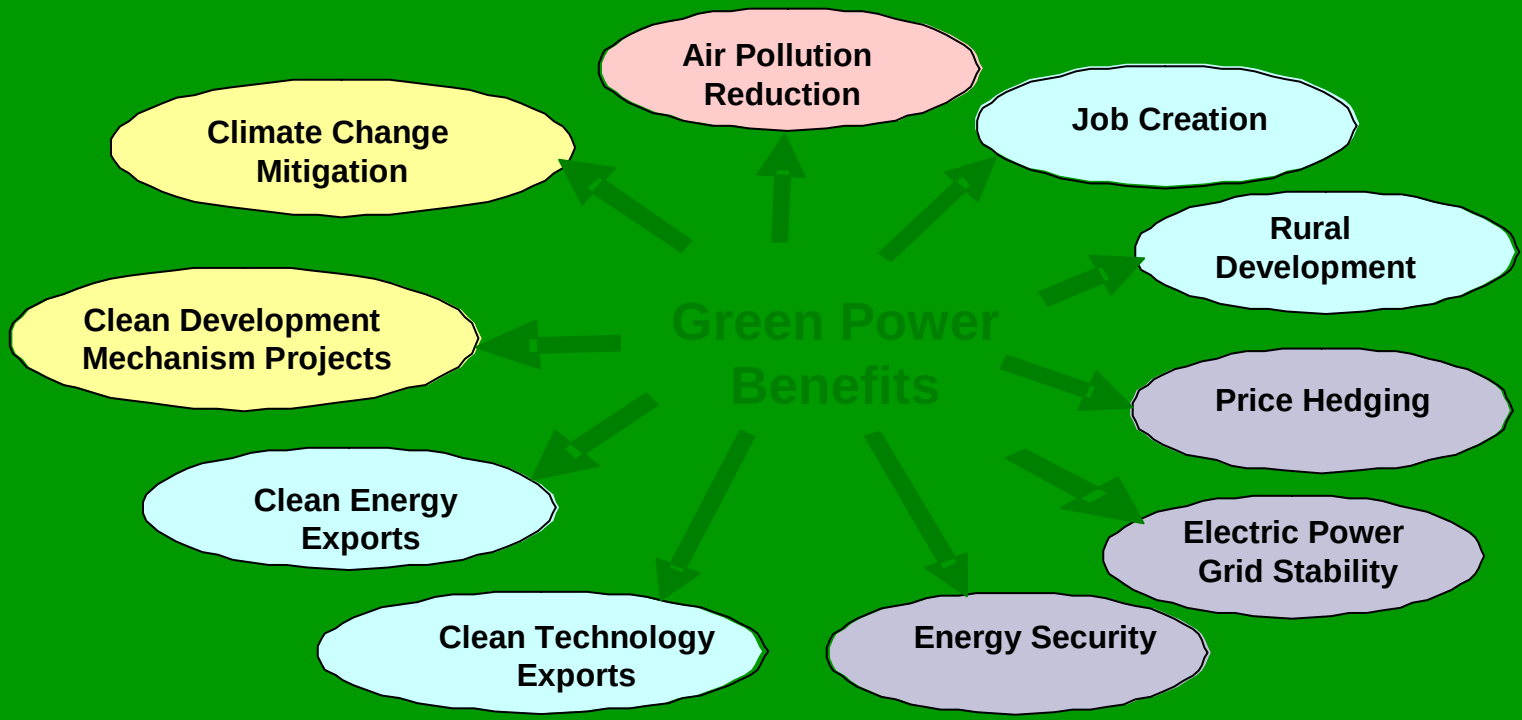
GREEN POWER COMPETITIVENESS

PROJECT	TYPE	FORECAST [¢/kWh]	SOURCE
Suroît, QC	Natural gas	7.0	Le Devoir, April 3, 2004
Bécancourt, QC	Natural gas, cogen	6.1	UQCN. 2003
Natural gas plant, BC (>60 MW)	Natural gas	5.5 – 8.1	BCH. 2004
“Site C” dam, BC	Large hydro	5.5 – 6.3	BCH. 2004
Coal plant, BC	Coal	5.5 – 6.5	BCH. 2004
Meager Creek, BC	Geothermal	5.9 – 7.0	Western Geopower
Wind power – 25 km from grid. QC	Wind	6.3 – 8.1	HM. 2004
Small hydro, BC	Small hydro	3.0 - 10	BCH. 2004
Biomass plant, BC	Biomass	5.5 - 19	BCH. 2004

GREEN POWER FILTERS


Theoretical potential of renewables
Large hydro
Small hydro
Wind
Biomass
Landfill gas, Waste incinera-tion, Co-firing
Tidal
Solar
Energy efficiency, DSM
Filter of technical feasibility
Filter of financial feasibility
Filter of social and environmental acceptability
Filter of greenness recognition
Filter of NIMBY or of "Nothing anywhere"
Note : This illustration is an evocation of a principle. It does not pretend to represent accurately the relative importance of the options, nor their rate of shrinking

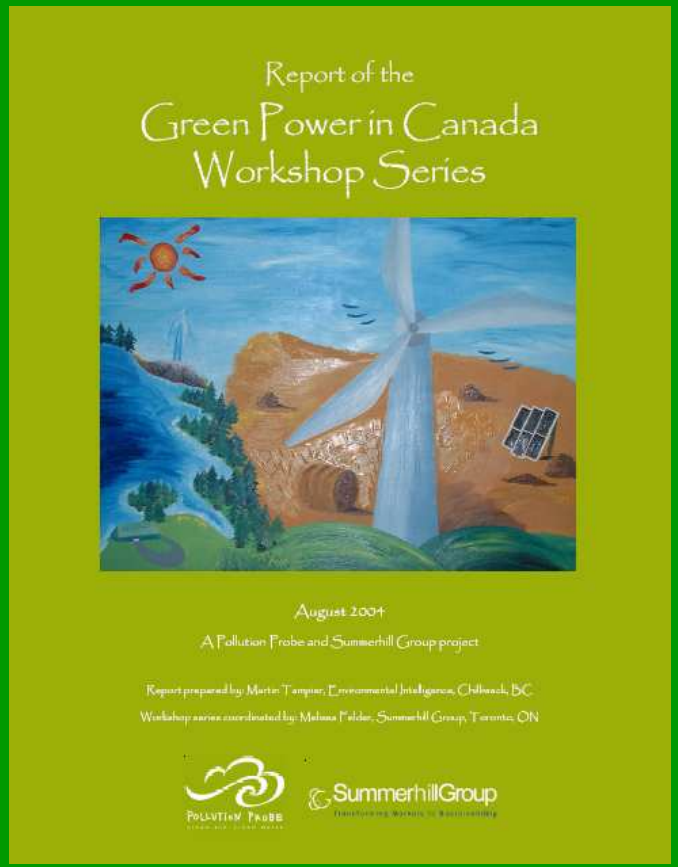
GREEN POWER BENEFITS

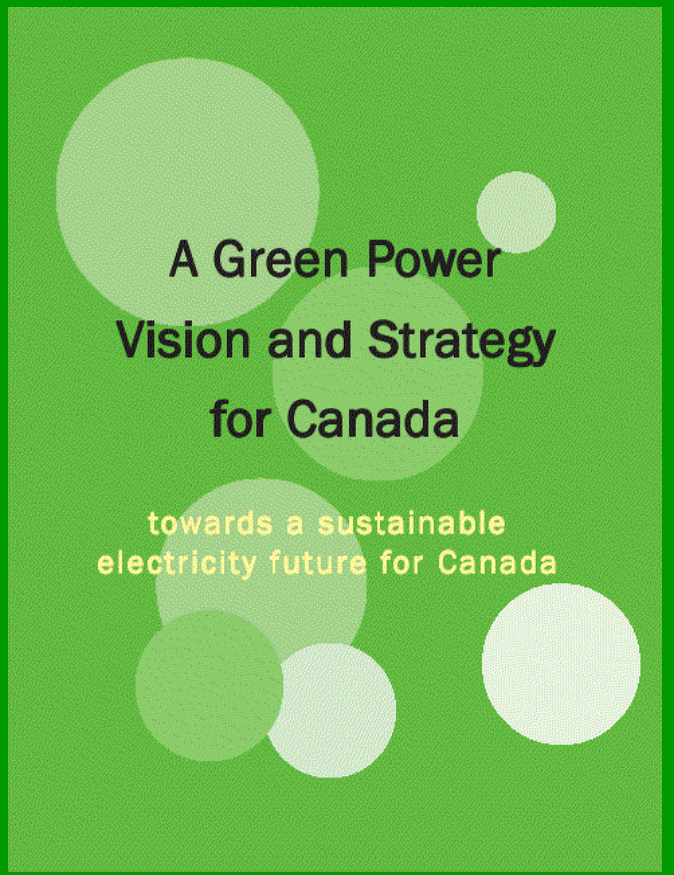


GREEN POWER ACTIVITY
(~ 30 TWh by 2010)

- BC – 50% new generation by 2012 (includes cogen)
- AB – 3.5% renewables by 2008
- SK – 150 MW of wind by 2005. All new generation to 2010
- MB – 1,000 MW by 2014
- ON – 5% new renewables by 2007. 10% by 2010
- QC – 2,000 MW of wind by 2014. 100 MW of biomass by 2008
- NB – 10% of new generation by 2016
- NS – 5% renewables by 2010
- PEI – 15% renewables by 2010 (30 - 40 MW wind)
- YT – 1 MW of wind increase by 2006
- NWT – 10% renewables by 2010
- NU – Increase in renewable energy in 1-2 community projects

GREEN POWER VISION & STRATEGY


Report of the
Green Power in Canada
Workshop Series
August 2004
A Pollution Probe and Summerhill Group project
Report prepared by: Martin Tampier, Environmental Intelligence, Chilliwack, BC
Workshop series coordinated by: Melissa Felder, Summerhill Group, Toronto, ON
POLLUTION PROBE
SummerhillGroup



GREEN POWER VISION & STRATEGY

Priorities for future electricity options:

- Energy efficiency and conservation
- Green Power that meets the criteria for EcoLogo certification
- Ecologically sustainable larger-scale hydro & other renewables
- Combined heat and power using natural gas
- The cleanest and safest technologies among the remaining options

GREEN POWER VISION & STRATEGY

Potential Green Power Portfolio for 2025

TECHNOLOGY	CAPACITY (MW)	CAPACITY FACTOR (PER CENT)	ELECTRICITY GENERATION (TWh)
Wind – onshore	21,000	30	55
Wind – offshore	3,400	40	12
Small hydro	10,000	50	44
Biomass	4,500	80	32
Geothermal	500	95	4
Solar	1,000	14	1
Wave	500	30	1
Tidal	500	30	1
TOTAL	41,400		150

GREEN POWER VISION & STRATEGY

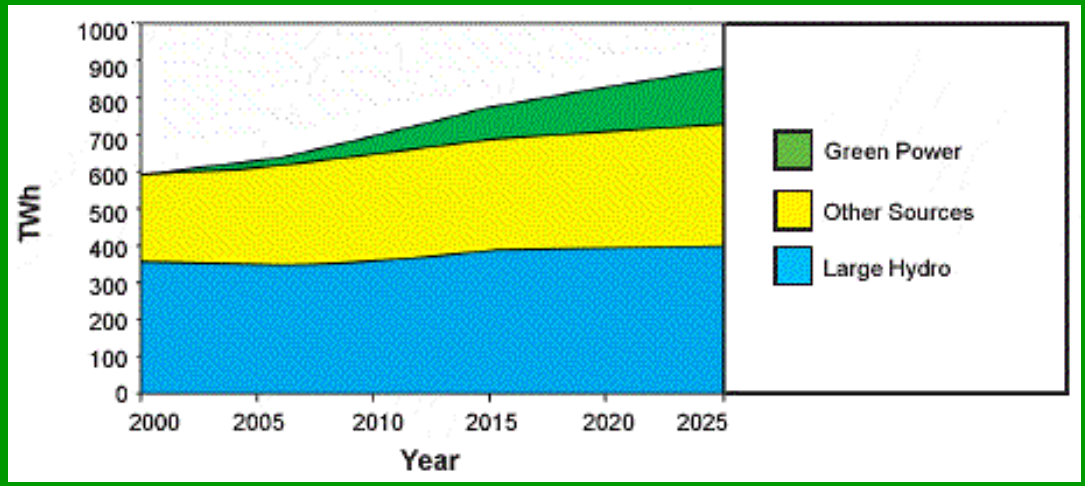
Green Power Targets for Canada

45-60	TWh of green power by	2010
90	TWh of green power by	2015
120	TWh of green power by	2020
150	TWh of green power by	2025

GREEN POWER VISION & STRATEGY

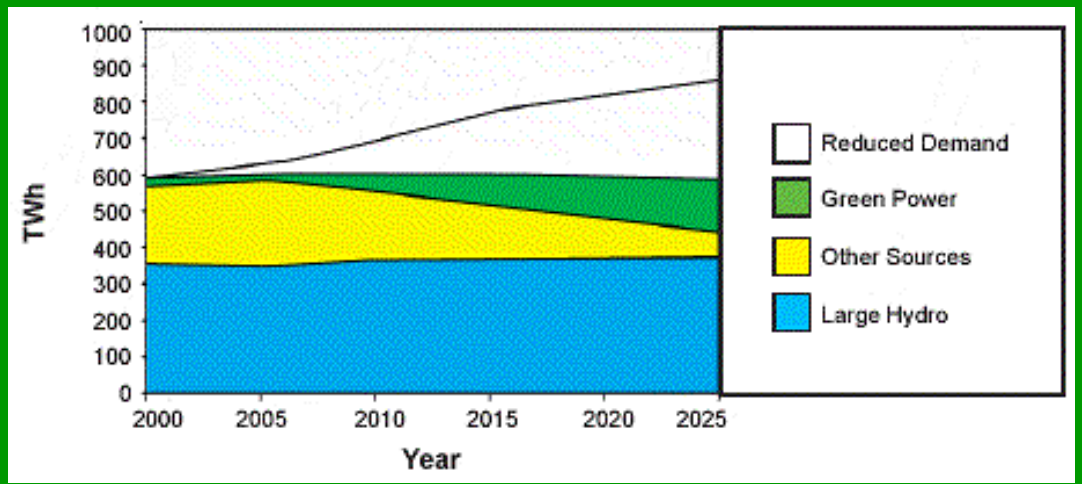
BUSINESS-AS-USUAL SCENARIO

17%



STABLE DEMAND SCENARIO

25%



PRIORITIES FOR ACTION

1. Leveling the Playing Field

- Renewable Portfolio Standards or Equivalent Policy Commitments
- Green Power Production Incentive
- Green Power Procurement
- Renewable Energy Certificate System
- System Benefits Charge

PRIORITIES FOR ACTION

2. Supporting Innovative Technologies

- Comprehensive Strategy for Research, Development, Demonstration & Commercialization
- Centres of Excellence
- Sustainable Development Technology Canada
- Technology Road Maps

PRIORITIES FOR ACTION

3. Engaging Canadians

- Community Engagement
- Community-based Projects
- Market Incentive Program - Increased and Extended
- Comprehensive Public Education and Outreach Strategy

ADDITIONAL ACTIONS

- Accessing the Power Grid
- Mapping Green Power Resources
- Establishing Mechanisms for Distributed Generation
- Streamlining Zoning, Planning and Permit Requirements
- Developing Standards to Ensure Quality and Safety
- Preparing the Labour Force
- Setting Up Green Power Coordinating Bodies

ONTARIO - ELECTRICITY GENERATION (2003)

POWER SOURCE	CAPACTY (MW)	GENERATION in 2003 (GWh/year)	PERCENTAGE OF TOTAL
Nuclear	10,720	61,040	39.2
Coal	7,285	35,098	22.2
Large Hydro	7,174	31,422	20.2
Oil & Gas	4,645	12,208	7.8
Imports	-	10,682	6.9
Conventional Sub-total	*29,824*	*150,450*	*96.6*
Wind*	15	39	0.03
Solar PV*	3	4	0.00
Small hydro*	491	2,803	1.4
Biomass*	455	3,189	2.0
Green Power Sub-total	*964*	*6,035*	*3.4*
Total	30,788	155,832	100

* Generation estimated based on known plant sizes and capacity factors for each technology.

ONTARIO - MINIMUM TARGETS FOR GREEN POWER (in GWh/year)

POLLUTION PROBE TARGETS	2010	2015	2020	2025
NATIONAL	45-60,000	90,000	120,000	150,000
ONTARIO *	12-16,000	24,000	32,000	40,000

* Interpolated from national target based on Ontario's relative share of total current electricity generation.

- Ontario, because of its tremendous resources, is expected to produce more green power than its relative share.

ONTARIO - COMPARISON OF GREEN POWER TARGETS (in GWh/year)

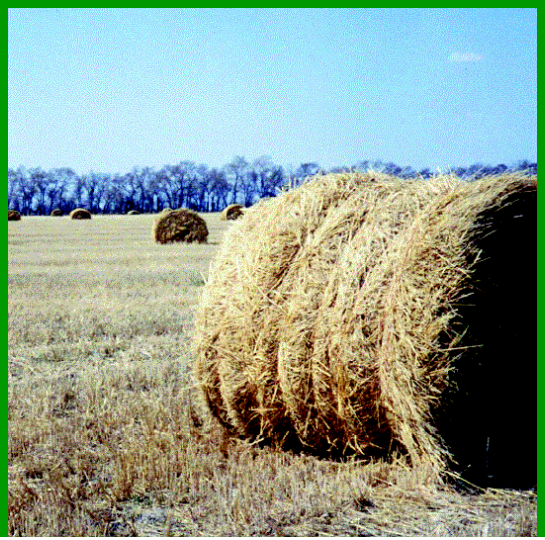
	2010	2020
Electricity Conservation & Supply Task Force*	22,241	42,469
Pembina Institute & CELA	22,090	39,797
David Suzuki Foundation	18,060	> 43,951
Pollution Probe**	> 12–16,000	> 32,000
Ontario Government target***	14,133	

*

** Interpolated from national target based on Ontario's relative share of total current electricity generation.

*** Estimate based on Ontario government target for new generation of 2700 MW (~ 8,751 GWh/yr) + existing generation (~5,382 GWh/yr)

NEW VISION FOR ONTARIO



THANK YOU!

www.pollutionprobe.org

POLLUTION PROBE

CLEAN AIR. CLEAN WATER.

PWU Meeting with OPA

September 20, 2005

OPA Legislative Tension

- OPA object (b)
  - "To conduct independent planning for electricity generation, demand management, conservation and transmission and develop integrated power system plan for Ontario"
- *Electricity Act* section 25.30 (2) Directive related to goal c:
  - "the phasing-out of coal-fired generation facilities"

PWU Submission

Public record should contain assessment of coal phase-out policy based on objective, quantifiable data.

PWU submission puts on public record impact of coal phase-out (No Coal) relative to continued operation of coal-fired plants retrofitted with emissions control technology (Clean Coal) on:

- Generation Costs
- Imports/exports of electricity
- Emissions reduction costs
- Future supply adequacy and reliability risks

Summary of Findings

Global Energy's high gas/high demand analysis:

- Generation costs in No Coal Case $11 billion higher than in Clean Coal Case
- No Coal Case results in additional $3 billion cost for incremental natural gas infrastructure, avoided in Clean Coal Case
- No Coal Case results in Ontario becoming more dependent on other jurisdictions for electricity
- 80% of emissions reduction in No Coal Case can be achieved at 20% of the cost in Clean Coal Case

Global Energy describes its base gas price forecast as conservative and this year's demand is already in excess of IESO's high demand forecast level for 2006-2010.

Summary of Findings (cont.)

No Coal supply adequacy and reliability risk include:

- Uncertainty in electricity demand growth
- Natural gas price levels and volatility, and availability
- In-service dates of new generation projects
- Completion of incremental infrastructure for new gas-fired plants
- Increased dependence on electricity imports and availability of electricity imports
- Complexity of transmission projects to accommodate new generation plants
- Decrease in generation load following capability

Summary of Findings (cont.).

Further Impacts of No Coal include:

- higher transmission costs related to major transmission projects required to maintain system reliability
- higher natural gas prices and volatility for gas end-users

Global Results Conservative

- Ontario net exporter at start of planning period
- Reserve margins excludes forced outages
- Maximum wind capacity available at 20% compared to IESO's 10%
- Some capacity assumptions may be aggressive and optimistic e.g. Pickering 1 will return to service as planned by the end of 2005, and Bruce 5-8 upgrades will proceed, imports from Labrador in 2013, and Manitoba imports start in 2017.
- Deterministic vs. stochastic analysis

CES Uncertainty

- By-pass rate
- Impact of natural gas price on credit requirement
- Cost of balancing service

PWU's Plan

- Rehabilitate existing coal stations with emission control technology
- Return to service all existing nuclear units
- Ensure coal and nuclear generation remain part of Ontario's supply through rehabilitation
- Proceed with new coal and nuclear generation using best available technology

Independent Planning

- Step back from plan which has not been independently, analytically and publicly evaluated
- Recognize potential deleterious economic impact and risk associated with No Coal Case and merit of Clean Coal Case
- Clean Coal strategy adopted in other jurisdictions
- Ontario's electricity consumers deserve a balanced energy strategy
- Adhering to rigorous and balanced analysis in assessing future supply mix will result in cleaner environment sooner and at substantially lower costs and risks than in No Coal Case.

What are OPA's Next Steps?

- OPA's path in establishing supply plan
- OPA's path in establishing Integrated Resource Plan
- OPA's plan for public process
- Canadians respect the environmental achievements of European countries
- We want to show Ontarians what can be accomplished with their coal-fired generating plants
- We think it is a model Ontario should follow
- Thank you for sharing your time and knowledge

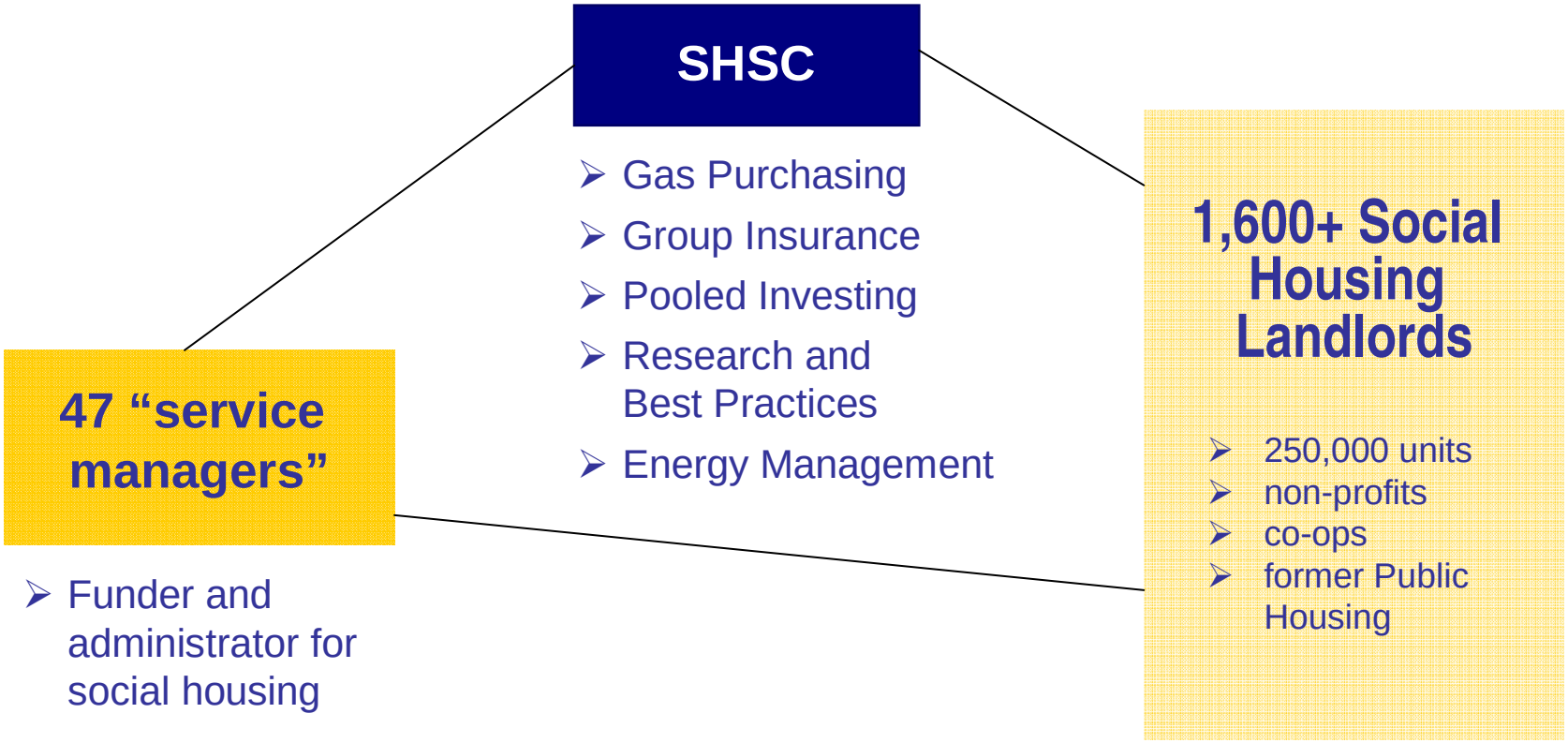
Social Housing Services Corporation and Energy Management

Presentation for OPA Supply Mix

October 4th, 2005

SHSC and social housing in Ontario

- SHSC is a not-for-profit corporation set up to help social housing landlords and their funders to manage housing programs more effectively



Connected to social housing province-wide

- SHSC was created by the Province as a channel to the social housing sector
  - creating economies of scale
  - deliver province-wide programs
- Solid record of effectively managing province-wide programs
  - keen understanding of customer base and market
  - natural gas purchasing program delivering 4,100,000 gigajoules/year
  - insurance program with $15 million in annual premiums
  - pooled investment program with assets of $320 million
  - province-wide data base – about buildings and data related to SHSC programs (including utility data)

What are we here to talk about?

- SHSC Energy Management Program Pilot

- SHSC Sectoral CDM Plan
  - Objectives
  - Strategy

Why SHSC and energy management?

- Help address rising energy costs
- Ability to deliver province-wide services
- Offer coordinated approach
  - With housing providers
  - With Service Managers
  - With utilities, provincial and federal governments
  - With suppliers of energy-efficient products

Energy use in social housing

(based on SHSC survey results to December, 2004 and audit results from 2005)

- Total utility costs for social housing landlords (250,000+ units) are over $400 million/yr, or 40% of overall budget (debt repayment)
- **Average electricity consumption – 13,889kWh/unit/year (average unit = 700 sq.ft.)**
- **Significant proportion of electric heat (almost 23% of units province-wide)**
- **Social housing landlords pay 82% of electricity costs**

What do we want to achieve?

- Province-wide channel to social housing sector
- Provide resources and tools
- Help providers save money
- Address maintenance backlogs
- Assist with capital renewal
- Lower energy use and emissions

What can we offer?

- Energy data management
- Standardized energy audits
- Resident education
- Staff training
- Help with financing
- Coordinated implementation
- Shared best practices

Piloting the Program

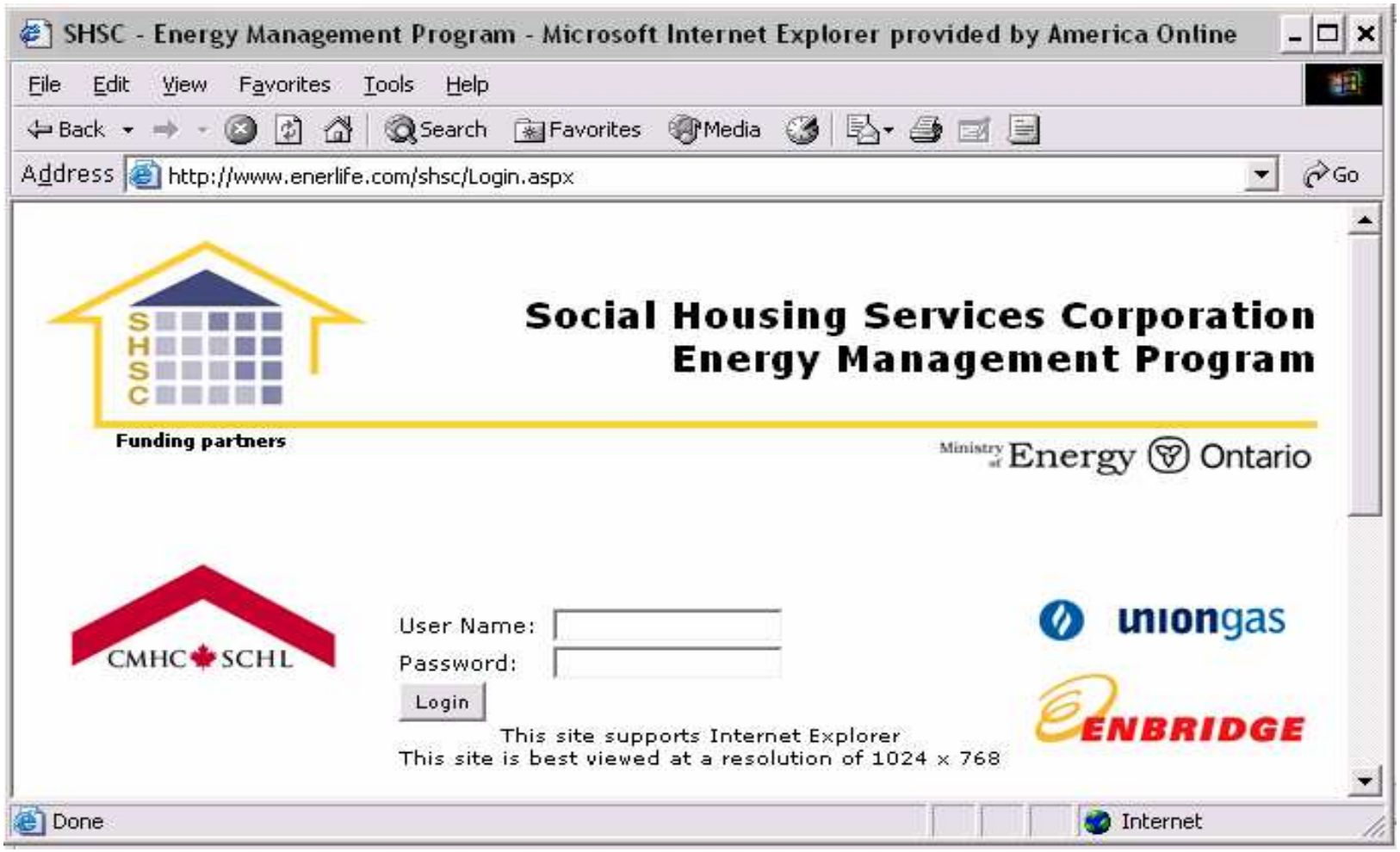
- Who's involved:
  - 20 service managers
  - 40 housing providers
  - 50+ buildings
  - 5,000 units

- Timeframe:
  - Launched March
  - Audits complete early summer
  - Data collection and analysis (ongoing)
  - Board approval early fall
  - Implementation beginning in the fall

Energy Management System

- **What kind of data and information will the system provide?**
- Energy use (kWh, gas, water, GHG)
- Tracking of utility costs
- List of energy efficiency measures
- Graphs and charts
- Benchmarking and comparisons
- Funding and grants
- Monthly savings reports

System Interface



Building Meter Details

Select Development | Summary | Development Details | Building | Utilities | Reports

Choose Building | Contact | Profile | Energy Meters | Energy Users | Energy Sources | Conservation | Resident Health | Responsibilities

Remember to save your changes before opening another folder.

Utility Supply

Utility	Supplier	Account No.	Area Served(general or specific eg. outdoor lighting)
Electricity	unknown		
Natural Gas	Enbridge		
Oil (for heating)	unknown	N/A	
Water	Region of		

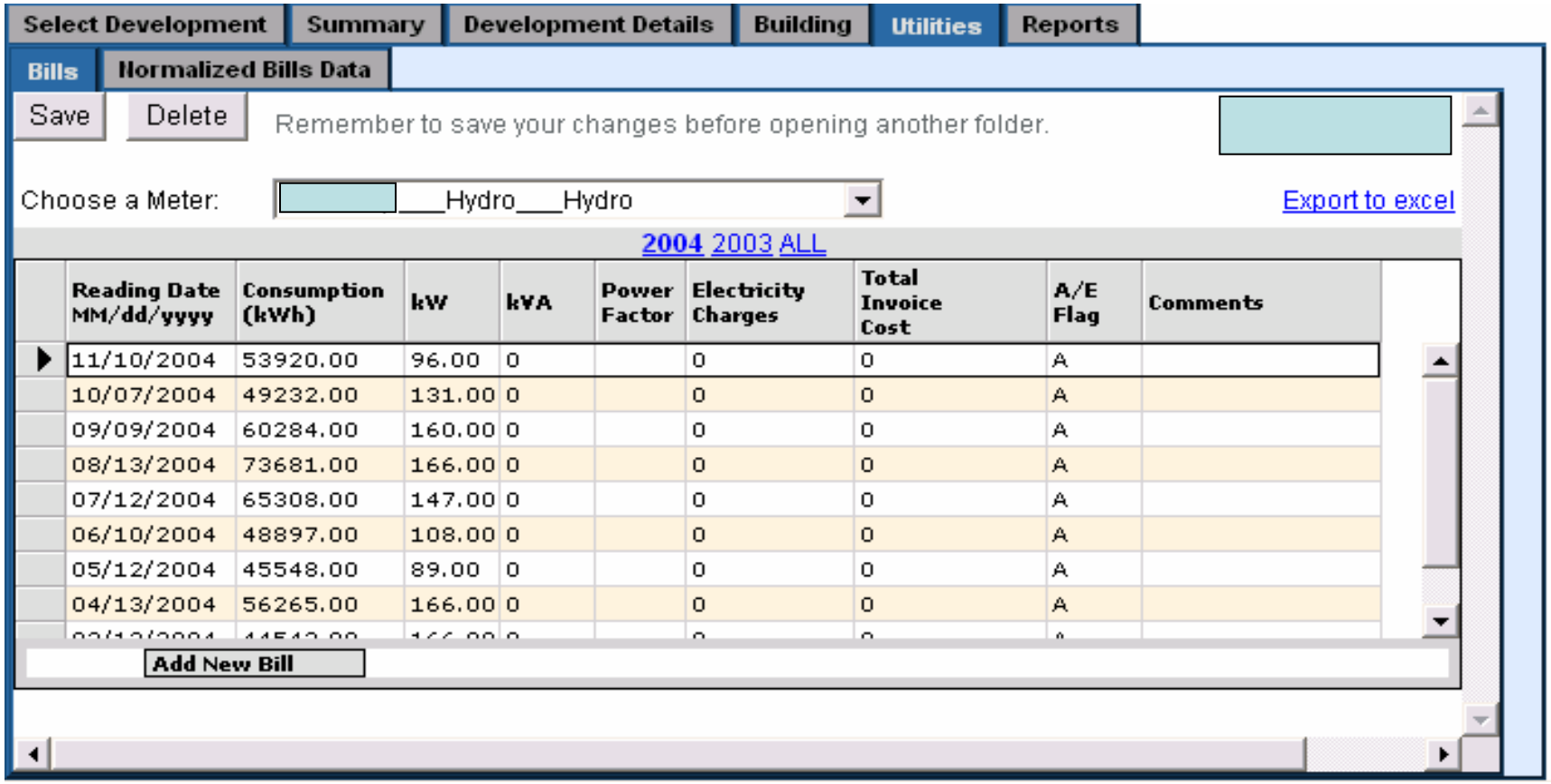
Water Supply: (•) municipal ( ) well

Sewage: (•) municipal ( ) septic system

Energy Metering for Residents

Meter Type	Suite Heating	Domestic Electricity	Domestic Hot Water	Domestic Water	
Central	☑	☑	☑	☑	Housing provider pays bills
Individual	☐	☐	☐	☐	Housing provider pays bills
Individual	☐	☐	☐	☐	Residents pay bills

Utility Data



What SHSC can do to help

- Oversight of standardized services
- Project management
- Involving residents – education and incentives
- Staff training and tools
- Monitoring results
- Communications

SHSC Sectoral CDM Strategy

Motivation

- *Energy Costs: $400 Million per year*
- *Sector Size: 250,000 housing units*

SHSC Sectoral CDM - Criteria

- ***Sectoral Benefits***
- ***Innovative Measures***
- ***Achieving Targeted Results***
- ***Leveraging Partnerships***
- ***Economic Development***

SHSC Sectoral CDM
- Strategy Overview

- ***Energy Efficient Retrofits/Renewables***
- ***Resident Energy Awareness and Practices***
- ***Energy Efficient New Construction Investment***

Refrigerator Replacement

- *Rationale: Refrigerator electricity consumption is a function of type, size and age of the appliance; constant usage*
  - Of the 5,000 housing units in our pilot, auditors recommended refrigerator replacement for 2000 units
  - SHSC's proposed 10-year refrigerator replacement program goal: 100,000 units

Lighting Replacement

- *Rationale: Pervasive measure; short-term payback; replication in many environments*
  - 50% of buildings in SHSC's Energy Pilot recommended for lighting retrofits
  - SHSC's lighting replacement program goal: 500,000 CFLs over 5 years

Strategy 1:
Energy Efficient Retrofits / Renewables

Market Readiness

- *Rationale: Wider sectors such as social housing must work to identify and implement innovative products for end-user installation*
  - Co-ordinate with CMHC, the Ministry of Energy, and LDC's province-wide to explore feasible applications for new technologies
  - SHSC's pilot provides opportunities to demonstrate renewable energies and innovation

Strategy 2:
Resident Energy Awareness and Practices

- *Rationale: Energy awareness is an important aspect of ensuring the success and sustainability of energy retrofit implementation*

  - SHSC's will combine energy awareness with implementation of energy measures
  - Community incentives used to transform measurable energy savings into community amenities and rewards

Strategy 3:
Energy Efficient New Construction

- *Rationale: Lack of energy efficiency in current social housing stock exemplifies the need for a new approach for new construction.*

- **SHSC's two pronged strategy**
  - Establishment of energy efficient design standards, including renewable energy applications for new construction
  - Establish a multi-year funding program providing upfront incentives and zero-interest loans for new energy efficient social housing construction

Partners supporting SHSC 's sectoral approach

- **Ontario Ministry of Energy**
- **NRCan**
- **CMHC**
- **Ontario Non-Profit Housing Association**
- **Co-operative Housing Federation of Canada**
- **Enbridge**
- **Union Gas**
- **Members of powerWISE** *(including Enersource, PowerStream,Hamilton Utilities Corporation, Toronto Hydro, and HydroOttawa)*
- **Milton Hydro**
- **HydroOne**
- **Enwin**
- **Kitchener-Wilmot Hydro**
- **Guelph Hydro**

SHSC's Energy Management Pilot

For more information:
Phone: (416) 594-9325
Website: www.shscorp.ca

Toward a Sustainable Future for Ontario's Electricity System:

Submission to the Ontario Power Authority from the Toronto Environmental Alliance on the proposed 'system mix' in Ontario, August 2005

Presentation by Keith Stewart, Ph.D. to the OPA

October 4, 2005

Hydro: The Decline and Fall of Ontario's Electric Empire looks at the past to answer the question:

How do we keep the lights on without frying the planet?

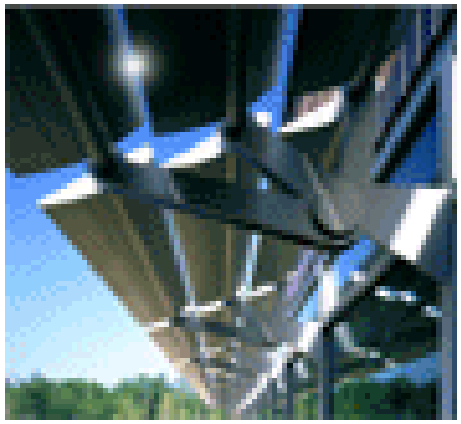
Short answer: Use less energy and use what we do truly need more creatively, working with and within, rather than against, nature.

Choosing our Path

The decisions we make today will shaper our electricity system for the next 25 years.

Coal is being phased out and the options on the table are to continue down the nuclear path, or to go green.

This is not simply a technical decision. The energy path we choose will have profound political, social and ecological implications.



Thesis of TEA's OPA submission: No one wants electricity!

- It is a mistake to think of electricity as a commodity or as a fuel (Walt Patterson).
- We want energy services:
  - light, comfortable homes and workplaces, safe storage & preparation of food, motive power, information handling.
- The best way to meet these needs:
  - Efficient use of energy;
  - Infrastructural energy (small-scale, decentralized, local systems that rely on flows of renewable energy rather than fossil or nuclear fuels).
- Challenge: intellectual inertia and vested interests within existing hub-and-spoke system.

See full report at www.torontoenvironment.org/node/282

The Green Alternative

1. Use the energy we truly need as efficiently as possible, while living within democratically-determined social and ecological limits.

2. Get this energy from sources that are:
   - o renewable
   - o diverse
   - o smaller-scale, local systems
   - o used to do what they do best.

3. The intelligent use of fossil fuels (e.g. natural gas) for a transition.

4. Address energy poverty by ensuring universal access to adequate, safe energy.

System Planning 1977 – 2005

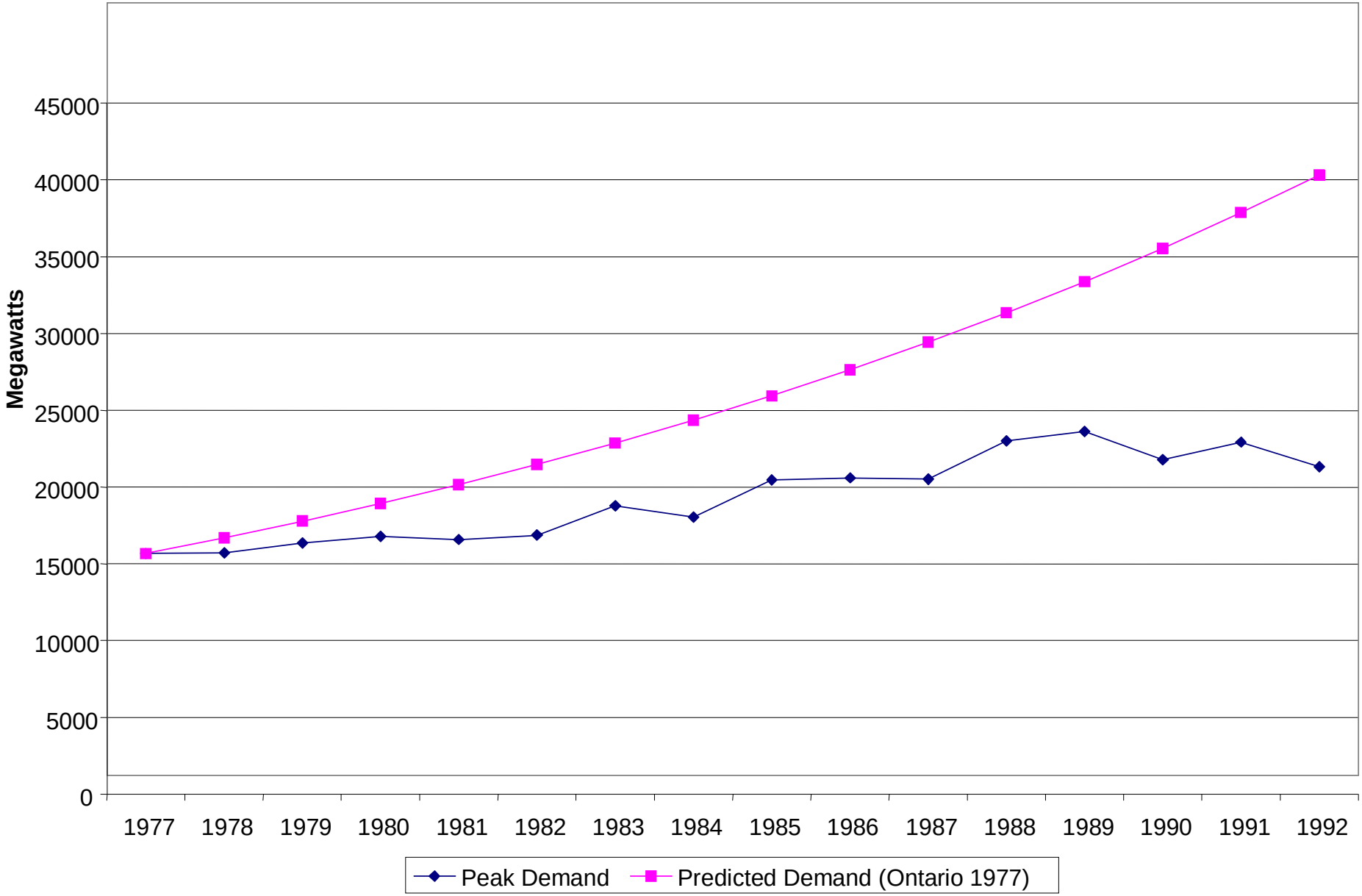
System planners have overestimated demand growth and assumed that the hub-and-spoke model is the only possible option to meet an economy-determined level of demand.

Key enviro message to Ontario Power Authority & Ontario government:

1. Plan to meet needs, not to deliver kilowatts:
   - electricity consumption has been 'decoupled' from economic growth.
2. Efficiency works, so don't be stampeded into new construction.
   - Greens have better record of predicting future demand than old-style system planners.

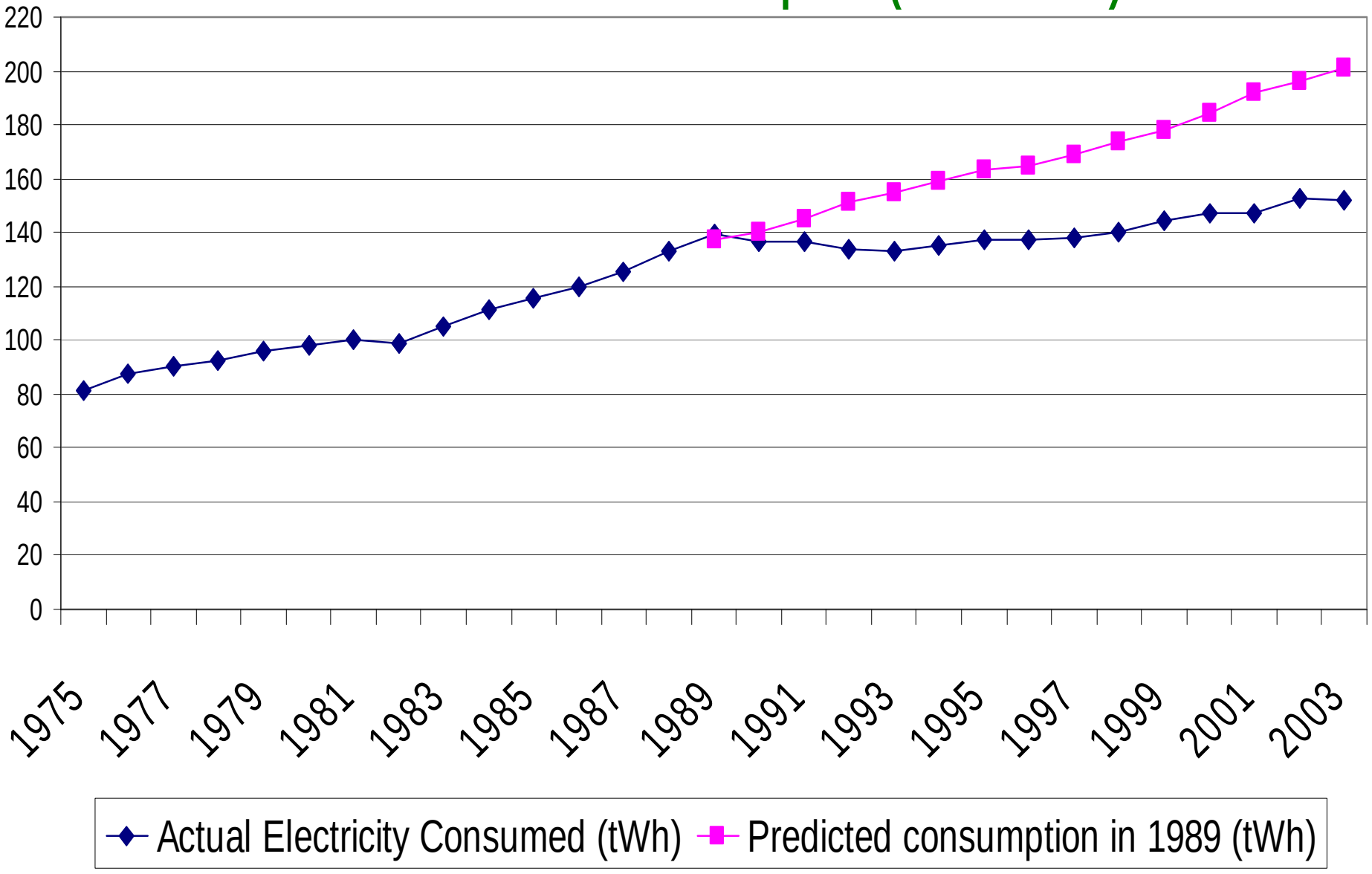
Actual versus Predicted Peak Demand in Ontario, 1977 – 1992

(Source: Ontario Hydro Annual Reports and Ontario Hydro Statistical Yearbooks)



Ontario Hydro 1989 Demand-Supply Plan:

Actual vs. Predicted Consumption (1989 - 2003)



Predicting the Future: The 21st century version

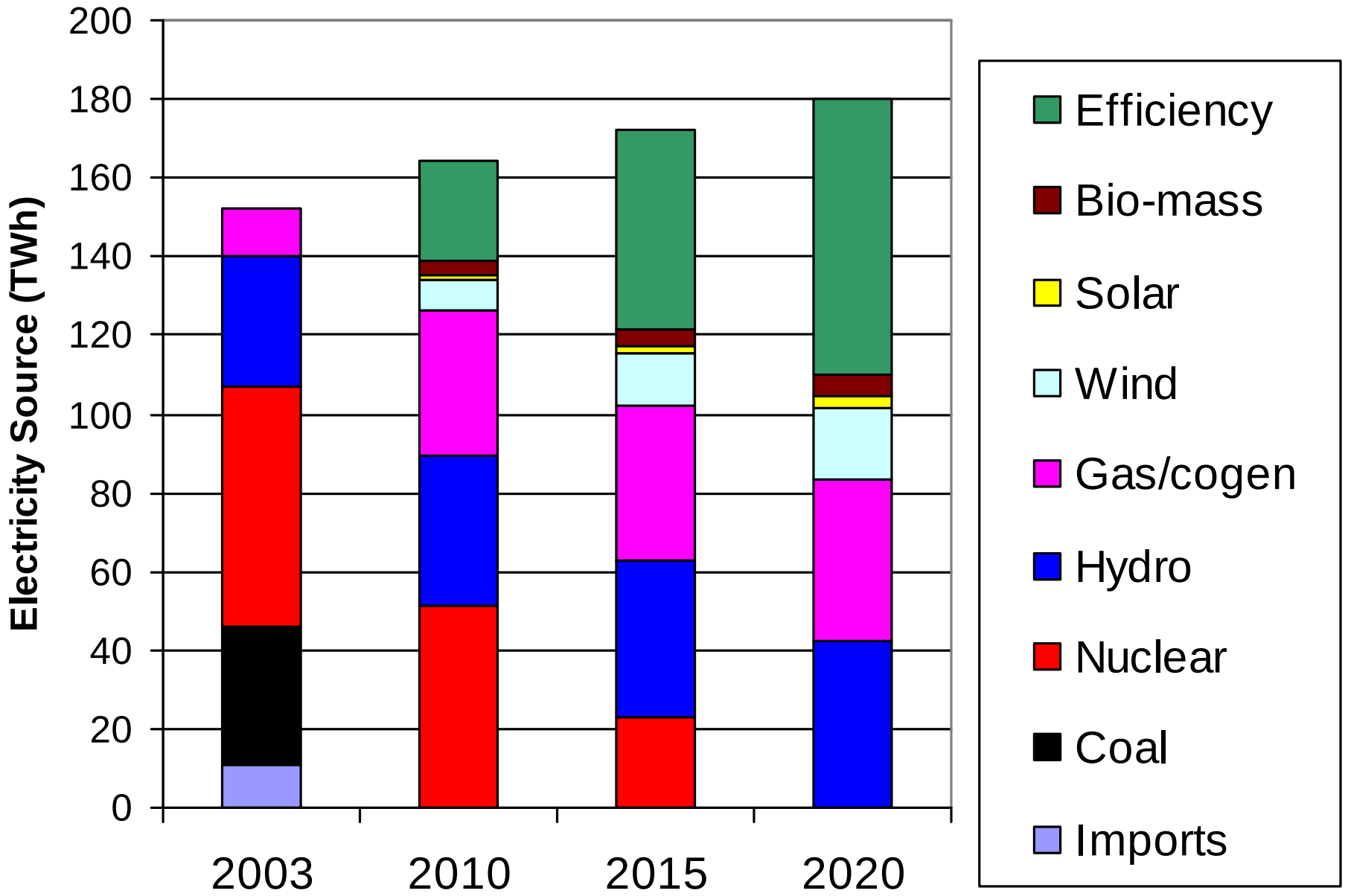
- Taskforce established by Ernie Eves says demand will grow at 1.1% / year.
  - Yet demand has only grown at 0.7% / year since 1989, without any serious attempt to reduce consumption.
- Conservation can only slow rate of growth (to 0.5%).
  - McGuinty government has scaled back conservation commitment from reducing demand by 5% by 2007 to slowing rate of growth of peak demand.
- Green power is nice window-dressing, but real men build nukes (and really want to keep coal).
- But… taskforce was dominated by energy industry, which doesn't make a lot of money by *not* selling you something.

What Could We do if we Tried?: *Power for the Future*

(2004 report by Pembina Institute & Canadian Environmental Law Association)

- Pembina and CELA used CIMS computer model to show how existing technology could reduce grid electricity demand by 40% relative to business-as-usual projections by 2020.
- $18 billion investment in efficiency, fuel switching and co-generation required over next 15 years, but 95% of this would be recovered by energy consumers through energy cost savings.
- Providing the same amount of electricity that could be saved by these investments through the construction of new nuclear generating facilities would cost more than $32 billion.

Proposed System Mix in *Power for the Future*



“To survive in the world we have transformed, we must learn to think in a new way. As never before, the future of each depends on the good of all.”
Statement of 100 Nobel Laureates on climate change and global peace
Oslo, December 2001